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BRITISH MACHINE TOOLS LEAD THE WORLD

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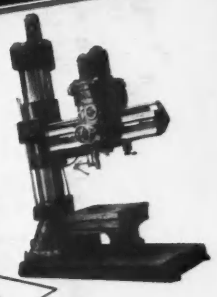

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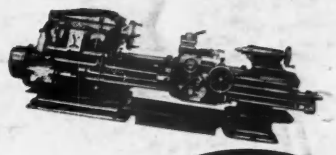

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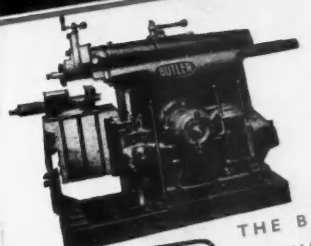

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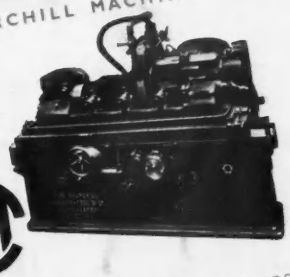

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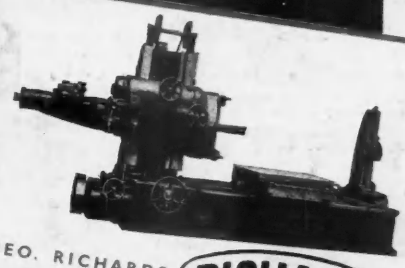

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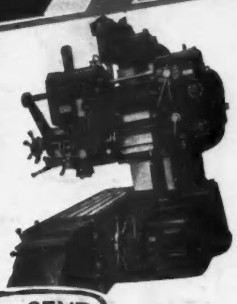

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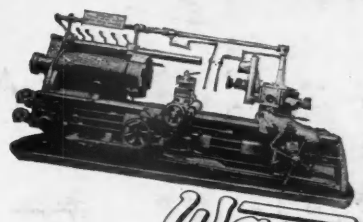

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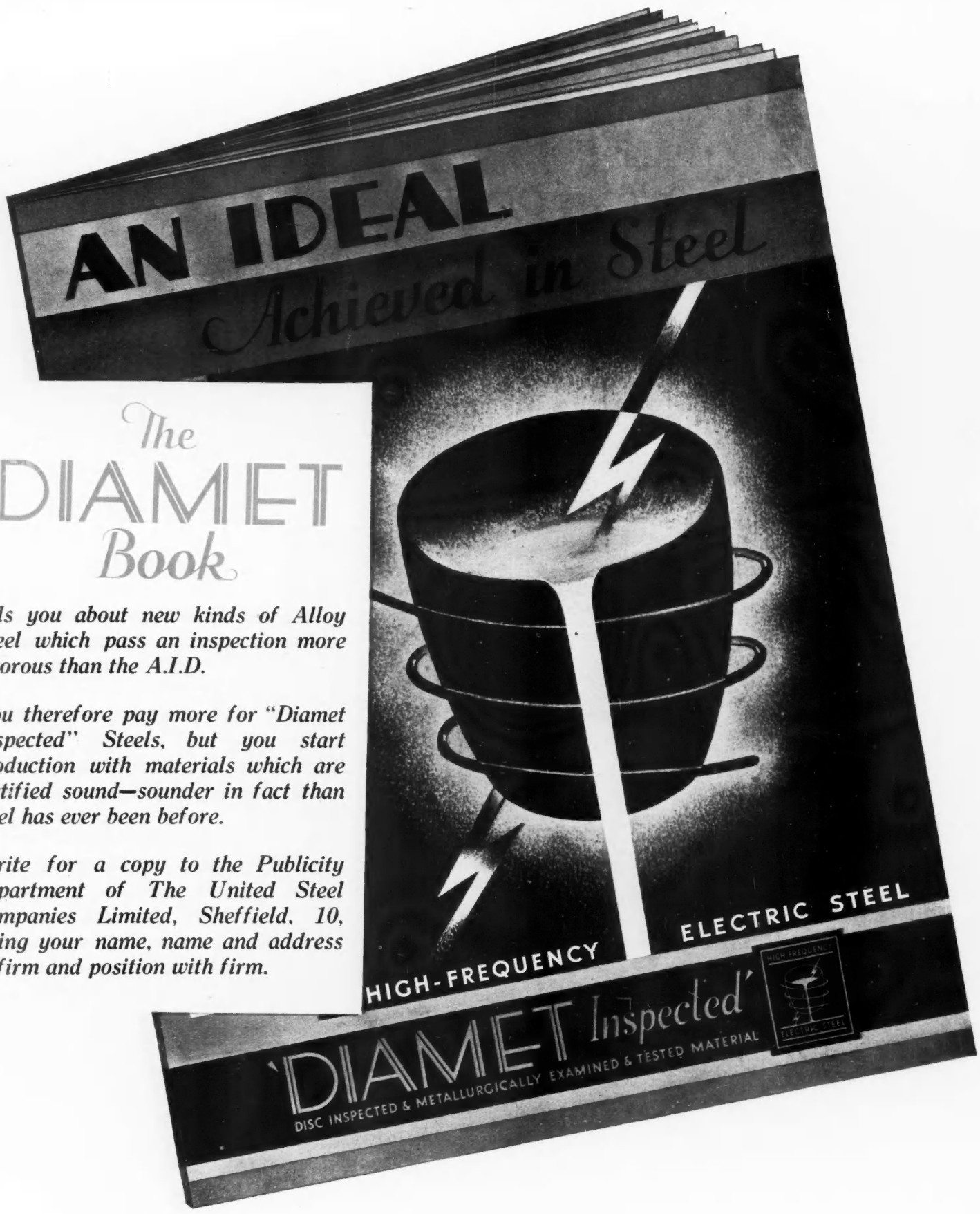

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JANUARY 4, 1935.—VOL. CLIX.

THE ENGINEER.

A Seven-Day Journal

The Unemployment Figures.

ACCORDING to a statement issued by the Ministry of Labour on Monday, December 31st, 1934, it is estimated that at December 17th, 1934, there were approximately 10,248,000 insured persons, aged sixteen to sixty-four, in employment in Great Britain. This figure was 36,000 more than at November 26th, 1934, and 237,000 more than at December 18th, 1933. There was a further improvement in employment between November 26th and December 17th in coal mining, in the cotton and motor vehicle industries, and in the distributive trades; some improvement was also recorded in the engineering industries. There was a decline in employment, however, in the building, pottery, and some other industries. On the same date the numbers of unemployed persons on the registers of employment exchanges in Great Britain were 1,717,005 wholly unemployed, 288,257 temporarily stopped, and 80,553 normally in casual employment, making a total of 2,085,815. This figure was 34,970 less than the number on the registers at November 26th, 1934, and 138,264 less than a year before. The total on December 17th, 1934, comprised 1,686,507 men, 56,277 boys, 299,192 women, and 43,839 girls. The number employed was the highest total yet recorded and the year the best since 1929.

L.M.S. and G.W.R. Construction Programmes.

THE London, Midland and Scottish Railway Company announces that it purposes to spend in 1935 £9,300,000 on major replacements and improvements. Its programme provides for the building of 287 locomotives and 175 locomotive boilers. Ten of the locomotives will be of the four-cylinder 4–6–2 express passenger "Princess Royal" class, thirty of the three-cylinder 4–6–0 express passenger class, along with 155 4–6–0 mixed traffic engines and twenty oil-electric shunting locomotives. The company will also construct 607 passenger coaches, twenty sleeping cars, and 10,050 freight wagons. The renewal of 600 miles of permanent way will be undertaken and bridges and viaducts rebuilt. Other works will include the building of the "Marchioness of Lorne" for the company's Clyde service and the "Duke of York" for its Heysham-Belfast route. The programme issued by the Great Western Railway for 1935 provides for the construction at Swindon of ninety-five new locomotives. Ten of these will be of the "Castle" class, and fifteen of the "Hall" class, while there will be a further ten standard goods engines and sixty tank engines. The rolling stock will include two ten-unit kitchen car centre corridor trains for special use, and 211 passenger coaches and vans, also 2486 freight wagons. Three hundred and ninety miles of track renewals are to be carried out and some 130 bridges rebuilt. The new stations at Bristol and Swansea are to be completed and the station at Leamington Spa remodelled, while extensive siding improvements are to be made at Old Oak Common.

New Year Honours.

WE enumerate below some of the names which appear among the New Year Honours bestowed by the King. Mr. R. D. Holt, the principal of Alfred Holt and Co., and chairman of the Mersey Docks and Harbour Board, is made a baronet in recognition of his public services. Knighthoods are conferred upon Colonel C. H. Bressey, Chief Engineer, Roads Department, Ministry of Transport; Dr. C. V. Boys, F.R.S., for services in physics; Alderman S. G. Kimber, Deputy Chairman of Southampton Harbour Board, for public services; and Mr. T. W. Stampe, Chief Engineer, Public Works Department, United Provinces, India, for services in connection with the Irrigation Branch. Engineer Rear-Admiral Robert Beeman, Deputy Engineer-in-Chief of the Fleet, becomes C.B. in the Military Division. In the Civil Division Sir Josiah Stamp is awarded G.C.B. for his public services; while Mr. Walter Eraut, Chief Engineer, Contracts Branch, the Crown Agents for the Colonies, becomes C.B.E., a like honour being conferred upon Mr. E. T. Ward, Engineer-in-Chief of the European Danube Commission. Mr. Vincent Hart, Chief Engineer, Public Works Department, Madras, becomes C.S.I. in the Order of the Star of India; while in the Order of the Indian Empire, C.I.E. is conferred upon Mr. F. J. Waller and Mr. M. R. Richardson, of the Indian Service of Engineers, Irrigation Branch, and Mr. C. G. Barber, the Superintendent of Works for the Cauvery-Mettur scheme. In the Order of the British Empire the honour of O.B.E. is conferred upon Mr. Roland Wheeler, City Electrical Engineer, Gibraltar; Major R. J. Clark, Engineer to the Middle Level Drainage and Navigation Commissioners; Captain A. J. Mayne, Chief Electrical Engineer, Aldershot Command; and Mr. E. T. Caparn, Superintending Engineer, Public Works Department, Baghdad.

L'Atlantique.

EXACTLY two years ago, on January 4th, 1933, fire broke out on the 42,000-ton French liner "L'Atlantique," which was proceeding to Le Havre for overhaul and repairs, and in a few hours the hull was practically burnt out. Since that time many efforts have been made to elucidate the cause of the disaster, and to decide whether or not the ship is a total loss. In Paris, on Friday last, December 28th, the Court of Appeal confirmed the judgment of the Commercial Tribunal of the Seine, which ordered the abandonment of the liner and the payment by the underwriters of the 170,900,000 francs, or about £2,278,000, for which the ship was insured. The Court rejected the underwriters' plea that the policy had been invalidated by the failure of the owners—the Compagnie Sud Atlantique—to reveal the existence of electrical defects. In allowing the claim for abandonment, the Court declared that, even if the vessel was repairable, her security would be doubtful, and that in any event the cost of the work would, in the unanimous opinion of the experts, exceed 100,120,000 francs. A criminal investigation into the cause of the fire is still proceeding at Bordeaux. Besides the capital sum above mentioned, interest to which the underwriters are liable amounts to some 15,000,000 francs, or about £200,000, while claims are being put forward for salvage services and the cost of dry-docking and maintaining the hull in dock pending the decision of the court. If the insurance companies should decide to appeal to the Court of Cassation, they may do so, but that Court is only competent to examine the points of law involved and not matters of fact.

An Extended Engineering Apprenticeship Certificate Scheme.

ON September 1st, 1932, a scheme was inaugurated in the City of Birmingham for the purpose of awarding engineering apprenticeship certificates to youths on attaining the age of twenty-one years who have received a thorough works training in the trade in which they are seeking employment, and have supplemented that works training by attendance at one of the city's technical colleges for three years. The scheme has been administered by a joint committee, consisting of representatives of the Birmingham and District Engineering and Allied Employers' Association and representatives of the Education Authority of the City of Birmingham, and already over 150 certificates have been awarded by this body. So far, the scheme has been confined to the City of Birmingham, but at the request of employers situated outside Birmingham and of the neighbouring education authorities, it has now been agreed to extend its operations to the whole of the area coming within the jurisdiction of the Birmingham and District Engineering Employers' Association, which covers the whole of the district lying between Stafford and Redditch, Worcs., and between Birmingham and Wolverhampton. Any engineering or allied apprentice who had completed his training on or after January 1st, 1934, can apply for the certificate, which is to be known in future as "The Birmingham and District Certificate of Apprenticeship in the Engineering or Allied Trades." The scheme has for its object not only the creation of first-class men in their own particular trade, but it is hoped that it will influence employers generally to take an interest in the training of young labour and make them encourage their youths to enter for the certificate. The secretary of the joint committee which is to administer the extended scheme is Mr. G. E. Niness, Phœnix Chambers, Colmore-row, Birmingham, 3, from whom full particulars may be obtained by all interested employers.

The Retirement of Mr. Sam Mavor.

THE announcement is made that with the end of the year Mr. Sam Mavor, the managing director of Mavor and Coulson, Ltd., of Glasgow, retired from the position of managing director of the company. He retains, however, the chairmanship of the firm. Mr. Mavor will shortly leave for a visit to South Africa. His successor is Mr. J. B. Mavor, a son of the late Mr. Henry A. Mavor, the founder of the firm. Mr. Mavor has for some time past taken a leading part in its designing work. Mr. Sam Mavor was born in Glasgow and graduated at Glasgow University, after which he gained his early training with the London establishment of Crompton and Co. He left London to join the firm of Muir and Mavor (now Mavor and Coulson), which in 1881 had been established by his brother, the late Mr. Henry A. Mavor. The firm was a pioneer in electrical coal-cutting machinery, and it established the first public lighting supply in Glasgow. Mr. Mavor has seen the business grow from small beginnings to the large and important undertaking he now controls. He has always taken a keen personal interest in bonus payment systems and in welfare work, on which subjects he is a recognised authority.

Navigation at Southampton.

AN agreement has been reached between Trinity House, the Cunard White Star Line, and the Southampton Harbour Board as the result of which a radio beacon for the benefit of ships will be placed on the Nab. The matter was brought before the Board last week in the report of the Works Committee, to which Trinity House had written recalling that the Board had undertaken to contribute £1000 towards the cost of the establishment and maintenance of the beacon, and informing the Board that the Elder Brethren had received an undertaking from the Cunard White Star Line, Ltd., to pay for the cost of maintenance for a term of five years. Trinity House, therefore, suggested a tripartite agreement, including the following provisions:—The Harbour Board to contribute in advance the sum of £1000 towards the first cost of the radio beacon, Trinity House to establish and maintain the beacon, Cunard White Star Line to pay an annual sum of £200 in half-yearly instalments for the maintenance of the beacon during a period of five years, Trinity House to have power to discontinue the beacon at any time in the interests of navigation or in the event of any change developing in the Nab tower, and the beacon to be at all times the absolute property of Trinity House. The Board resolved to reply to Trinity House that it would be prepared to enter into a tripartite agreement on the conditions outlined. The French Line, whose ships are to call at Southampton after January 30th, has also asked for a radio beacon and has expressed its readiness, if necessary, to assist towards its maintenance.

Rebuilding a Viaduct.

FOLLOWING the reconstruction of three other viaducts, the Broadholme, Belper Pool, and Swansley viaducts on the London, Midland and Scottish Railway Company's Derby-Leeds line, the company has decided to reconstruct in steel and concrete the Burleigh viaduct, which carries the railway across the river Derwent about 3¼ miles north of Derby. Preliminary work has already been begun by the contractors, Mitchell Bros. and Sons, Ltd., of London, and some 600 tons of structural steel work is being supplied by the Butterley Company, Ltd., of Derby, and cylindrical steel caissons by the Horsehay Company, Ltd., of Wellington, Shropshire. The work will be so ordered that no interruption of the railway services will take place. The steel cylinders will be sunk in the bed of the river by compressed air and will be then filled with concrete. It is expected that the work will occupy about seven months and will be completed by the end of June.

Aeronautics in 1934.

No. I.

ON every side the year was a momentous one in the aeronautical world. Both as regards administration and technical achievement events occurred which are certain to have marked effects on the future development of military and civil aviation alike.

Of outstanding importance on the military side were the steps taken by the Government to implement the policy, announced in November, 1933, of raising the aerial strength of this country to equality with that of any other Power within striking distance of our shores. In March on the occasion of the introduction of the Air Estimates it was announced that as a beginning the gross expenditure on the Air Service, instead of being decreased as in previous years, would be increased by £527,000 and that six new squadrons would be constituted. That expansion, it was pointed out, would raise to about 900 the total number of first line machines at the disposal of the Air Ministry for carrying out all the duties with which it was charged and would increase our strength for strictly home defence purposes to 540 machines or, say, ten per million of the population. In July the programme of expansion was widened to cover the provision of forty-one squadrons during the next five years. These new squadrons will consist of a total of 460 machines. Thirty-three of the new squadrons will be allotted to home defence, raising the total for that purpose to seventy-five, while the remaining squadrons will be used with the Fleet Air Arm or overseas. The Government's policy as thus outlined is intended to be an elastic one. It will be kept constantly under review in the light of developments abroad. It may be adjusted to increase our security or it may be modified if success should attend the efforts which the Government intends to continue towards securing some measure of aerial disarmament.

On the civil side marked evidence was forthcoming of a change in the attitude of both the Government and the general public towards commercial aviation. In July the report was issued of a Committee presided over by Lord Gorell which had been appointed to give renewed consideration to the question of relaxing official control over civil flying. Among the recommendations of this Committee which the Air Council accepted was one under which the control of airworthiness for civil aircraft should be devolved to a Board formed from the Joint Aviation Advisory Committee of Lloyd's Register and the British Corporation Register. The Air Ministry is, however, for the present to retain control over the airworthiness of the larger passenger aircraft used on regular air transport services. Two recommendations made by the Committee were rejected. It advised the transference of the administration of civil aviation from the Air Ministry to a purely civil Department of State and that, until such transference was accomplished, the Civil Aviation Directorate should be made as self-contained as possible within the Air Ministry and the Director of Civil Aviation given an improved status. These recommendations were rejected in a reasoned statement by the Secretary for Air which accompanied the report. Nevertheless before the year expired the second one was in effect accepted. In December it was announced that the Director of Civil Aviation was to be given the rank of Director-General and that he together with the Secretary for Air and the Under-Secretary would form a group, apart from the Air Council, to deal with all questions affecting civil aviation.

On the civil side the year will long be remembered as that which witnessed the great Australian air race. For that contest twenty machines left this country in the early hours of October 20th in competition to reach Melbourne in the shortest actual time or at the highest flying speed. The principal prize was won by Messrs. Scott and Black flying a de Havilland "Comet" twin-engined monoplane who crossed the finishing line 2 days 23 hours after leaving England. Their time to Australia was actually less than one-third of the previous record. This performance was remarkable in itself and also for the interest which it aroused in the public mind. In certain quarters it led to an outburst of criticism of British civil aviation in general. Our machines, it was said, were too slow and the Government's encouragement of civil aviation was too niggard. On November 21st Lord Londonderry, the Secretary for Air, replied to the attack of the critics in a lengthy statement in the House of Lords. He not only satisfactorily disposed of their arguments but succeeded in the more important object of demonstrating the fundamental soundness of the official policy with respect to civil aviation as compared with the extravagant or otherwise unsound policies pursued by certain other countries.

On December 20th in the House of Commons the Under-Secretary of State for Air disclosed far-reaching proposals for the development of Empire air communications. The details of the scheme were approved by his Majesty's Government in the summer and the receipt of the views of all the other Empire Governments concerned is now awaited. If those Governments agree to co-operate and support the scheme three main improvements will become effective. Firstly the existing time schedules for the air services between the several parts of the Empire concerned will be very materially improved. Secondly the frequency of the services will be substantially increased. Thirdly all first-class mail for the Empire countries concerned will be carried by air. If the scheme becomes effective India will be reached in just over two days, East Africa in two and a-half days, the Cape or Singapore in four days and Australia in seven days. Provision is to be made for four or five services a week to India, three a week to Singapore and East Africa and two a week to South Africa and Australia. It is hoped that letters posted in the United Kingdom will be carried to Empire destinations at the rate of 1½d. per half ounce. It is anticipated that about two years will be required to bring the scheme to fruition.

IMPERIAL AIRWAYS.

During 1934 Imperial Airways, Ltd., began its second decade of flying. An indication of the progress made during the company's first ten years may be gained from the fact that, whereas in 1924–25 its machines flew 853,000 miles and carried 291,000 ton-miles of traffic, by 1933–34 these figures had increased to 2,354,000 miles flown and 2,733,000 ton-miles of traffic carried. During its first ten years of operation the company also improved its figure for flights completed to schedule from 75 per cent. in 1924 to 98 per cent. in 1934.

In 1934 traffic on the European services was not only maintained but improved. On the India and Malaya route traffic continued to show a steady growth. On the Africa route the traffic figures revealed an increase of more than 40 per cent. as compared with 1933. On the air extensions to Rangoon and Singapore, which had been opened towards the end of 1933, the traffic figures showed a steady and encouraging increase. As a result of continued traffic pressure on the Africa and India routes it was decided, towards the end of the year, to increase the frequency of these services to twice weekly, the first of the duplicated services being scheduled to leave the London air port on December 30th. On the India route the duplications are to operate between London and Calcutta, and on the Africa service between London and Johannesburg. Their effect will be to give a twice-weekly service in each direction between Great Britain and Palestine, Iraq, the Persian Gulf, India, Sudan, Uganda, Kenya, Tanganyika, Northern and Southern Rhodesia, and the Union of South Africa, and four return services weekly between Great Britain and Egypt—which is served by both the India and Africa routes.

Regular flying over the final sections of the Eastern air mail, from Singapore to Port Darwin and on to Brisbane, began with the departure of a 2-ton Christmas mail load from the London air port on December 8th. The air mail from London to Brisbane is the longest air route in the world, and brings to a total of more than 20,000 the mileage of the services operated by Imperial Airways and its associated companies, Indian Trans-Continental Airways, and Qantas Empire Airways. The next links in the Empire air chain will be the extension of the Australia route to New Zealand and the establishment of an ocean air service which will enable the existing trans-Empire routes to be extended to join up with the air mail system of Canada. Imperial Airways has been paying constant attention to the question of operating an Atlantic air service, and following the researches which have been in progress the company is about to order, under agreement with the Air Ministry, an aircraft which should, it is believed, have a range and pay load that will satisfactorily meet the conditions of an Atlantic air mail service.

A number of new aircraft were under construction for the company during 1934 and are to be delivered shortly. Three of these new machines are to be fitted with four engines and four of them are to be twin-engined. The top speed in each case will be in the neighbourhood of 170 miles an hour. It was also decided during 1934 to order two flying boats and two land planes of types larger than any at present in the company's service. These new aircraft, the tenders for which are under consideration, will have a carrying capacity of from 3½ to 5 tons, and their speed will exceed that of any of the company's existing fleet. One of the new flying boats will be required for the Bermuda-New York service which Imperial Airways is to operate in conjunction with Pan-American Airways.

The establishment of auxiliary services, feeding the main air lines, represents a valuable aspect of progress on the Empire air routes. In its development policy in this direction Imperial Airways acquired during 1934 an interest in Wilson Airways—an organisation which has been opening up local air services in Kenya and Tanganyika. In the previous year an interest had been acquired in Rhodesian and Nyasaland Airways.

One of the most interesting developments in civil aviation during 1934 was the progress made with air lines operating within the British Isles. After acquiring parliamentary powers to establish air services, the four main line railway companies, in conjunction with Imperial Airways, formed the organisation known as Railway Air Services, Ltd. This new company, during 1934, operated internal air services between Liverpool, Birmingham, Cardiff, and Plymouth; between Birmingham, Bristol, Southampton, and Cowes; between London, Birmingham, Liverpool, Isle of Man, Belfast, and Glasgow; and, in conjunction with Spartan Air Lines, between London and Cowes. On the routes operated by Railway Air Services new express air liners of the "Diana" type were brought into service. These machines are driven by four engines, developing a total of 800 h.p., and carry ten passengers, mails, and freight at a maximum speed of 175 miles an hour and at a cruising speed of 150 miles an hour. To encourage the dispatch of letters by these internal air lines the Post Office instituted a policy of consigning mails by the routes named above at ordinary rates, without any aerial surcharge. In November the further step was taken by the Post Office of introducing a lower flat rate for mails air-borne along the Empire routes, the effect being that letters for destinations such as Kenya, Uganda, Tanganyika, Rhodesia, South Africa, India, and Malaya can now be sent at a reduced charge of sixpence per half-ounce, and those to Egypt, Iraq, and Persia for threepence per half-ounce.

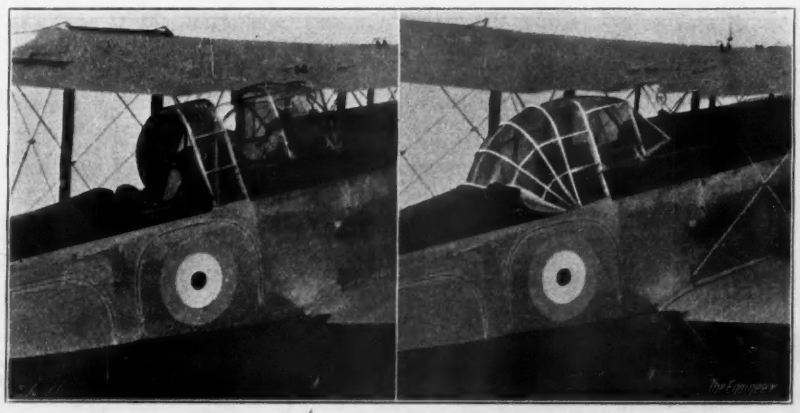
WESTLAND "PTERODACTYL" MARK V TWO-SEATER FIGHTER

THE BRITISH AIRCRAFT INDUSTRY.

On the side of technical development much interesting progress was made during the year. In what follows we deal in detail with the activities of representative British aircraft manufacturing firms. On the aero-engine side the progress was equally if not

more marked, and will be dealt with in a later section.

Westland Aircraft Works.—The provision of protecting hoods of transparent material for the pilot and gunner formed a noteworthy modification of the "Wallace" general purpose and day-bombing machine. The enclosures, as illustrated herewith, consist of a sliding coupé hood for the pilot with adjustable windows and a quick-release roof and a folding segmental hood for the gunner. The rear end of the gunner's hood when closed meets the fuselage decking while the front end abuts against the rear of the pilot's coupé. The gunner by pushing the hinged sectors forward and up can slide them within a fixed section of the hood immediately in rear of the pilot and is thereby enabled to work his gun while protected



WESTLAND "WALLACE" TWO-SEATER COCKPIT ENCLOSURES

from the slipstream blast by the front portion of the hood. In this way the gun may be used while the machine is flying at its top speed. With these enclosures a small amount of warm air from an exhaust heated jacket gives the occupants a high degree of comfort. The arrangement is claimed actually to improve the all-round view of the occupants as it renders unnecessary the high waistline normally adopted to exclude draughts.

Of the experimental types of machine produced and tested during the year the single-seater fighter designated F. 7/30 which we illustrate in a Supplement is of especial interest in so far that it embodies a novel disposition of the engine. In this machine the tractor screw is driven through a gear-box in the nose. A shaft running through the pilot's cockpit couples this gear-box to the engine—a Rolls-Royce "Goshawk"—which is installed in an enclosure between the wings. The pilot's position above the shaft and in front of the wings and engine gives him a commanding view. To increase his field of vision rearwards the top wings are swept down into the fuselage at the centre section. The cockpit is completely enclosed to protect the pilot when the machine is operating at great heights. The side windows of the enclosure may be opened at will while the roof may be slid rearwards in emergency. The machine is of the standard Westland duralumin construction. It is equipped with four guns firing forward and with provision for a number of small bombs.

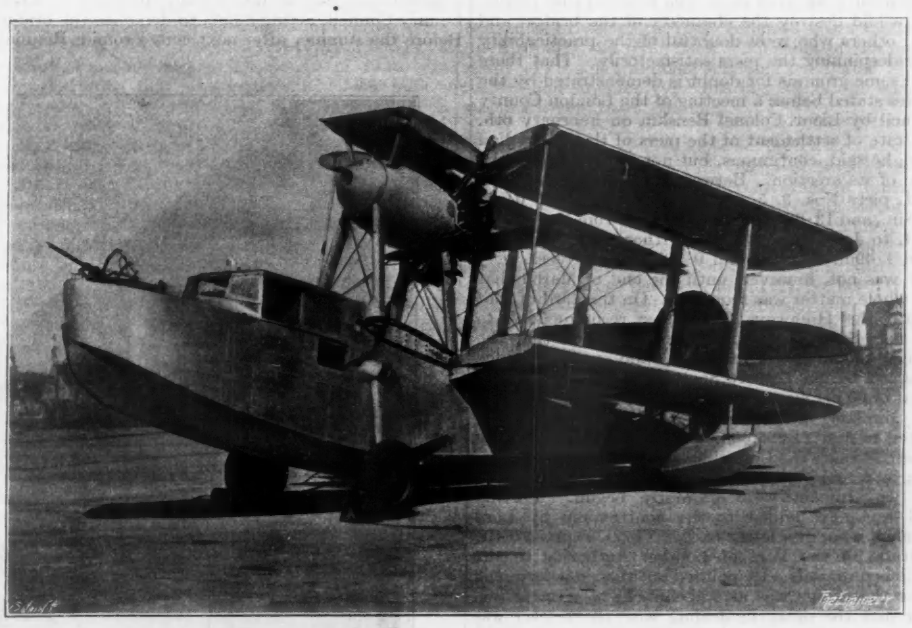
Another interesting machine tested during the year was the new design of Pterodactyl. This machine, known as the Mark V, and illustrated on page 2, is a development of Captain—now Professor—Hill's tailless type which has engaged the attention of the Westland works for the past eight years. It represents a considerable advance in horse-power, all-up weight, wing loading and performance. The machine is a two-seater fighter and is driven by a Rolls-Royce "Goshawk" engine. While in general form it resembles the previous designs it is distinguished therefrom by being fitted with a tractor screw instead of a propeller thereby enhancing its military advantages. In addition the large swept-back top wing characteristic of the Pterodactyl design is supplemented by two small tapered lower wings. These lower wings are not swept back. The top wing is braced to them by means of struts and streamline wires. The skid structures are attached to the lower wings and are connected by bracing to the upper wing. For the undercarriage two wheels in tandem are provided, the forward wheel being steerable and the rear wheel being fitted with a brake. Two large hinged flaps, one at each tip of the upper wing, may be operated simultaneously as elevators or differentially as ailerons. The wing tips also carry single-acting rudders.

In addition to these machines the company also carried out some interesting work with autogiros and constructed both a large and a small machine of this type.

The Bristol Aeroplane Company Ltd.—In its aircraft department the Bristol Company produced a considerable number of "Bulldog" single-seater fighters both for the Royal Air Force and for export. The "Bulldog" is now in use not only in this country but by the Air Forces of Australia, Sweden, Denmark, Latvia, Estonia, Siam and other countries. A new type known as the "Bulldog" Mark IV was introduced. This machine is driven by a Bristol "Mercury" VI S. engine with a supercharger for operating at a high altitude and with a geared-down airscrew. For some years past the company has been developing the "all-metal" machine to its logical limit namely to the extent of abolishing even fabric for the fuselage and wing coverings. A machine of this true all-metal type is the "Bristol 133" illustrated in a Supplement. This machine is a high-performance single-seater interceptor fighter and is driven by a "Mercury" VI S engine. The engine is enclosed in a Townend ring of long chord and embodying the exhaust collector. The machine, it will be seen, is a low-wing cantilever monoplane. The wings are cranked, that is to say, from the tips each slopes downwards to a line immediately above the landing wheels and then rises to meet the underside of the fuselage with the result that viewed from the front the two wings together make up a very flat W. The undercarriage is retractable, the legs being enclosed in fairings which blend, in the retracted condition, into the wings at the points where they are cranked. Another development of the company's work on all-metal construction was exhibited at the recent Paris Aero Show in the form of an all-metal fuselage of monocoque construction for a commercial machine. The machine to which this body will be fitted will be a low-wing monoplane with a retractable undercarriage and driven by two Bristol "Aquila" sleeve-valve engines. The noteworthy developments in the company's aero-engine department will be dealt with in a later section.

Hawker Aircraft, Ltd.—During the year Hawker Aircraft, Ltd., of Kingston-on-Thames, acquired the business and works of the Gloster Aircraft Company, Ltd., of Cheltenham. By this step output was increased and the design of experimental machines was facilitated. The company in its enlarged capacity continued to experience great activity in the execution of orders for the re-equipment of the Royal Air Force and for foreign governments. The standard Hawker types known as the "Hart," "Audax," "Demon," "Fury," "Nimrod," and "Osprey" were supplemented by two new designs, the "Hardy," a general purpose machine, and the "Hind," a day bomber. Both these machines are of metal construction and are driven by Rolls-Royce "Kestrel" engines. The Gloster "Gauntlet" a general purpose single-seater fighter equipped with a Bristol "Mercury VI" engine was put into production at Cheltenham and an R.A.F. squadron has been equipped with it. To Sweden the company supplied a number of "Osprey" machines to be driven by Swedish-built Bristol "Pegasus" engines while to Portugal machines of the "Fury" type driven by Rolls-Royce "Kestrel" engines were delivered. In addition orders were received from three other foreign governments. On the experimental side the development of the high-speed "Fury" fighter was continued. With the latest improvements this machine now has a speed definitely exceeding 250 miles an hour and a very high rate of climb. At the R.A.F. display a new experimental type the Hawker four-gun fighter fitted with a "Goshawk" engine made its first public appearance. This machine of which we give an illustration in a Supplement is a development of the "Fury" and "Nimrod" designs. At the Gloster works a four-gun fighter to the same specification but equipped with a "Mercury" VI engine was also produced. These two machines are now being subjected to experimental trials. For machines intended for service with the Fleet Air Arm the company continued to make use of stainless steel for the structural members. It has been demonstrated beyond dispute, we are assured, that the advantages gained by the employment of this material more than compensate for the higher initial cost.

Vickers (Aviation), Ltd.—The Vickers "Vildebeest" torpedo bomber which we illustrated as a seaplane in January, 1932, and as a land plane in January, 1933, was in production in the second-named form during the year for the Royal Air Force and for the New Zealand Government. The "Valentia" troop carrier, a modified form of the earlier "Victoria," fitted with Bristol "Pegasus" air-cooled engines was also in production for the R.A.F. A general purpose aircraft known as the "Vincent" was introduced. This machine is driven by a "Pegasus" engine and is capable of executing a wide range of duties including torpedo carrying. In the photograph of it which we reproduce in a Supplement it is shown fitted in place of the torpedo with an additional fuel tank for long-range work. It will also be noted that it is provided with a hooked rod for the purpose of picking up messages from the ground. At the Supermarine Aviation Works there was considerable activity in the production of flying boats. The "Scapa" twin-engined type to which we referred a year ago was in production for the Royal Air Force while for the Royal Australian Air Force work was done on an order for twenty-four "Seagull" amphibian flying boats. The latest design of "Seagull" machine is illustrated on this page. The photograph reproduced shows the machine prepared for stowage in an aircraft carrier with the wings folded and the landing wheels lowered. When the machine is to be used for alighting on water the landing wheels are raised within cylindrical recesses on the underside of the lower wings. The engine is a 600 h.p. Bristol "Pegasus" and as will be noted drives a propeller instead of the more usual tractor screw. In addition to being an amphibian the "Seagull" has also been successfully catapulted. During the year the Supermarine Works departing for once from the production of marine aircraft produced a purely land machine, a low-wing all-metal, single-seater day-and-night fighter driven by a 600 h.p. Rolls-Royce "Goshawk" engine. On the accessories side Messrs. Vickers developed a new design of air-operated wheel brake and an improved form of oleo-pneumatic undercarriage gear.



VICKERS SUPERMARINE "SEAGULL" V AMPHIBIAN

(To be continued.)

Bridges and Tunnels of 1934.

TO Londoners, at least, the year 1934 will always be notable as the one in which, after long delays, a decision was reached as to what ought to be done with Waterloo Bridge. It will be recalled that at this time last year the matter appeared to be settled. With some reluctance, since there was no prospect of a grant being made available towards the cost of a new bridge, the London County Council had agreed to the governmental scheme for corbelling out the old bridge and underpinning a number of the piers. Tenders for the work were on the point of being invited. The proposal had aroused a good deal of opposition, both from those who believed that corbelling would destroy the character of the bridge, and from others who were doubtful of the practicability of underpinning the piers satisfactorily. That there were some grounds for doubt is demonstrated by the figures stated before a meeting of the London County Council by Lieut.-Colonel Benskin on February 6th. The rate of settlement of the piers of the bridge had been, he said, continuous, but not uniform, since the time of its erection. Between 1820 and November, 1931, piers Nos. 3, 5, and 8 had settled by 5·04in., 28·8in., and 13·025in. respectively. From November, 1931, to January, 1934, the further settlements had been 1·09in., 0·27in., and 0·78in. respectively.

It was not, however, until the end of March that the whole matter was reopened. On the 23rd of that month the Highways Committee recommended to the now Socialist London County Council that the bridge should be demolished, and a new bridge designed by Sir Gilbert Scott erected, subject to a grant of 60 per cent. of the cost being obtainable from the Ministry of Transport. Rebuilding was estimated to cost £1,295,000, as against £685,000 for reconstruction. The Council adopted the recommendation by a majority of 77 to 53, and negotiations with the Government were promptly begun. Further fuel was next added to the controversy by Lord Ritchie, who, in a letter to *The Times*, expressed the attitude of the Port of London Authority to the various proposals. He pointed out that in its crippled state the bridge was an impediment to river traffic, and that the delay in dealing with the matter was becoming intolerable. From the point of view of the Authority, the ideal would be demolition of the old bridge and the erection of a suspension structure. If that suggestion were regarded as impossible, the new bridge should not have more than five arches. On the other side, Mr. E. B. Beck, at a meeting of John Mowlem and Co., Ltd., pointed out that the construction of a new bridge would mean the closing off of road traffic for six years, two of which would be required for the removal of the old bridge. If reconditioning were undertaken, only three months' closure would be necessary.

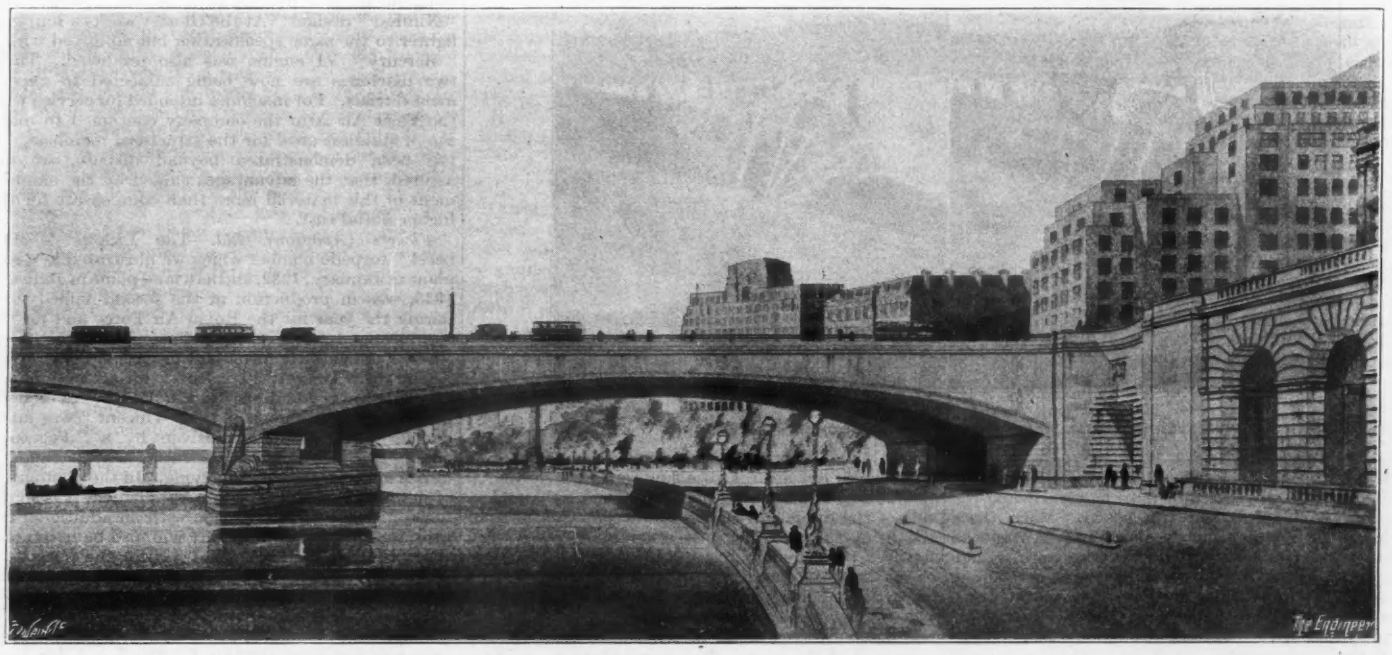
Matters moved rapidly in May. Early in the month there was a meeting at the House of Commons to discuss the views of the Port of London Authority, and on the 30th the Council's proposal to demolish the bridge was put to the free vote of the House in the form of a Money Bill and rejected by a small majority (194–159), after a long and evenly balanced discussion. Less than a week later an obstinate Highways Committee was deciding to recommend demolition, despite this adverse vote in the House of Commons, and on June 12th, rather to the surprise of London, which had become used to continual delays, the London County Council confirmed this decision. Within a fortnight, so rapidly did matters now move, the parapets of the bridge began to disappear. For the sum of £200,000, Sir William Arrol and Co., Ltd., undertook the contract for the demolition work, for which the engineers are Messrs. Rendel, Palmer and Tritton. For a few weeks London waited and wondered what the Government would do, hardly realising, after such long delays and such protracted negotiations, that it was within the powers of the County Council, acting alone, to demolish the bridge. Before the summer after next comes round, Rennie's Waterloo Bridge will be a memory, not a vestige of which will remain except for an occasional baluster erected as a sundial in some suburban garden. At the time of writing, the whole of the roadway has been removed, and temporary girders stretch across above the arches from each side of the river towards the centre. Soon the arches will begin to disappear. On October 19th details of the design by Sir Gilbert Scott for the new five-arch bridge were issued, and we illustrate on this page the probable appearance of the span passing over the Embankment.

Controversy is not yet completely stilled, and there are still those to be found who view with obstinate resistance the removal of a bridge of undoubted architectural beauty and historic associations. But faced by a *fait accompli*, the greater number of Londoners, we believe, are better satisfied that something should have been done at last than that the interminable controversy should be continued.

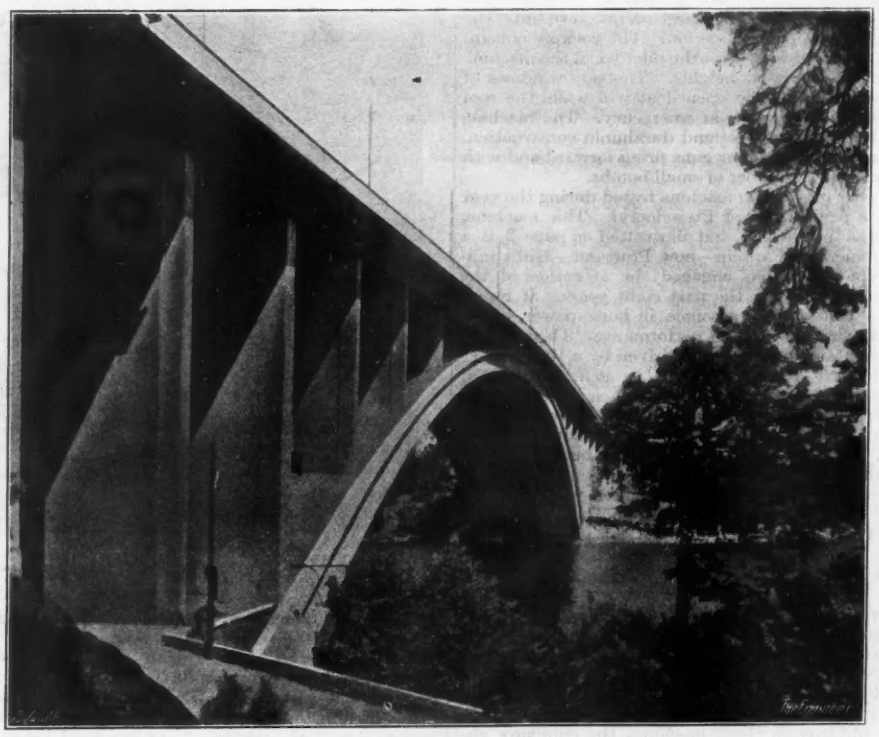
In March the design of another bridge in London was decided upon. It was towards the close of 1933 that a decision was taken to reconstruct the Chelsea Bridge at a cost of £480,000. It is to become a steel suspension structure, with piers and abutments of granite and will have a central span of 332ft. and side spans of 163ft. each. The carriageway will be 40ft. in width between two footways, 12ft. wide.

As far as the Charing Cross Bridge is concerned, the project is by no means dead. On October 30th the question as to whether it is required, and in what general form, was referred to the newly formed London and Home Counties Traffic Advisory Committee. Sir C. H. Bressey, too, who has been appointed to make a survey of the highways of London, will no doubt consider the advisability of constructing it.

The year 1934 was also notable for the fact that in February there was declared open by His Royal



PROBABLE APPEARANCE OF EMBANKMENT SPAN OF NEW WATERLOO BRIDGE



THE TRANEBERG ARCH BRIDGE, STOCKHOLM

Highness the Duke of York the first bridge of the vertical lift type to be constructed in this country. The Newport (Tees) Bridge, for the construction of which Messrs. Mott, Hay and Anderson were the engineers and Dorman, Long and Co., Ltd., the contractors, is claimed to be the largest structure of its kind in the world. It has a span of 265ft. 4in. between the bearings of the moving portion, which carries a 38ft. carriageway and two footways 9ft. wide. The bridge, which is illustrated in a Supplement to this issue, provides, in the raised position a clearance of 120ft., and the width of navigable waterway is 250ft. The actual lifting bridge is a link in a work of considerable magnitude, which involved the construction of several minor bridges over roads and railways to bring the approaches to the river. In our issue of March 2nd and following issues the whole work was described and illustrated.

No other bridges of comparable importance were erected in this country during the year, although work continued on the strengthening of weak road bridges and the erection of new ones. There was, however, further discussion of the proposal for a bridge across the Firth of Forth to be placed either at Rosyth or at Queensferry. A survey of the former site has already been begun and will be continued.

The Mersey Tunnel.

By far the most important work completed in this country during the year 1934 was the Mersey tunnel connecting Liverpool and Birkenhead. With an internal diameter of 44ft. and a cross-sectional area of 1680 square feet it constitutes the largest subaqueous tunnel ever built in the world. It is unnecessary here to write very much about it, since in a series of illustrated articles beginning in our issue of July 13th we described it fully. The main tunnel, which has a length between portals of 10,584ft., runs from the Old Haymarket, near St. George's Hall on the Liverpool side, to Market Place South, near Chester-street, in Birkenhead. This tunnel has a roadway 36ft. in width to carry four lines of traffic. In addition to the main tunnel there is on the Liverpool side a dockside branch to carry two lines of traffic with its entrance at New Quay north of Chapel-street, and on the Birkenhead side a similar branch tunnel with its entrance at Rendel-street. These branch tunnels have a horseshoe cross section 26ft. 6in. internal diameter. The landward ends of the main tunnels are semi-circular in cross section. The roadway of the main tunnel is set 1ft. 6in. below the horizontal diameter and is formed as a reinforced concrete slab 12in. thick at the centre. Two longitudinal diaphragm walls support it and form a more or less square section tunnel beneath the road. It was originally intended that this space should be used to accommodate tramways, but this project was abandoned and, though nothing whatever has been settled, there has been some talk of reserving it for pedal cyclists. The spaces between the vertical diaphragm walls and the lining of the tunnel itself are utilised for air supply purposes. In the semi-circular tunnels there are passages underneath the roadway between the reinforced concrete slab and the invert through which the air supply is taken. Six ventilation plants, three on each side of the river, supply the necessary air. The cost of the tunnel works, including the land but excluding interest charges during construction, was about £7,077,800, towards which the Government contributed £2,500,000. The remainder of the cost will be met out of loans, the loan charges being provided by tolls over a period of years and out of rates to be levied in Liverpool and Birkenhead. It is very satisfactory to be able to note that the success of the tunnel has exceeded even the most optimistic forecasts. In our Supplement this week we reproduce a page of photographs of this great work, the engineer for which is Sir Basil Mott, with whom is associated Mr. J. A. Brodie, Past-president, Inst. C.E. Sir Basil's partners, Mr. David Hay and Mr. David Anderson, shared with him the responsibility for the design and constructional work. Many other experts to whom reference was made in our articles last July were also concerned on special matters of design and construction.

Europe.

In our Annual Article last year we referred to the approaching completion of an interesting concrete arch bridge in Sweden. The Traneberg arch bridge spans the harbour of Stockholm, with a clear span of 178·4 m. between abutments. We described the features of its construction in our issue of September 15th, 1933, and there is no need to make further reference to it here than to direct attention to the photograph reproduced on page 4,* which demonstrates the æsthetically satisfying nature of this style of architecture. Another large bridge in the same district is the Vasterbron, connecting the northern and southern parts of Stockholm, now nearing completion. It is of iron, and has a length of 601 m., a width of 24 m., and a clearance height of 24 m. In connection with this bridge there has been built a smaller one over the little sound of Palsundet, which is remarkable in so far that there are no rivets in it, the whole construction being welded together. The Vasterbron will be ready for use in the autumn of 1935. Another European bridge to which attention may be directed is that with a vertical lifting span near Barendrecht, illustrated in the Supplement. It spans the Oude-Meuse waterway in Holland, and is the largest bridge of its kind on the Continent. The steelwork was designed and supplied by Werkspoor, of Amsterdam. The bridge has a lifting height of 40·50 m., and gives a width of free passage for shipping of 50 m. The length of the lifting span is 67·32 m., and its total weight 446 tons. Each of the side legs is a latticed steel structure supported on two masonry piers, and, unlike the Newport bridge, the two legs are connected together by steelwork at the top.

Another important bridge to be credited to the year 1934 in Europe was that opened on December 16th by Prince Paul across the river Save, to connect Belgrade and Zemun. It is known as the King Alexander I Bridge, and is a suspension structure with a clear span of 804ft. It was constructed jointly by a French and a German firm, and was started 4½ years ago. Together with its approach viaducts it has a total length of 1967ft.

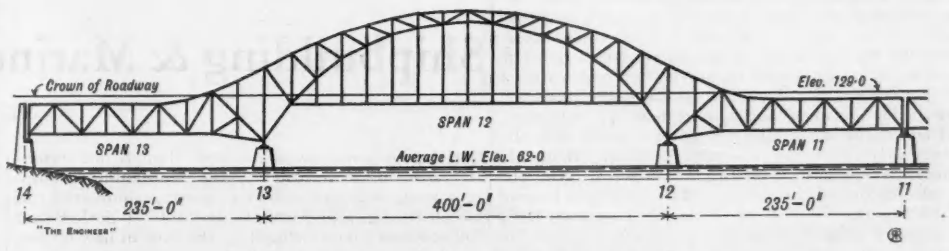
Africa.

Outside Europe one of the most imposing structures to be completed was the Lower Zambesi Bridge, illustrated on this page, which, having a length of 11,650ft. 9in. over a river which in the winter season fills the whole of that width, is claimed to be the longest railway bridge in the world. The Hell Gate Bridge, New York, is actually some thousands of feet longer, but the greater part of that length is over land and not water. The illustration, which shows span following span into a vague and misty distance, gives an excellent impression of the great length of the bridge. This structure forms the principal part of a scheme now approaching completion for interconnecting the Central Africa and Trans-Zambezia railways, and has been built by the Cleveland Bridge and Engineering Company, Ltd. It will form a very important link in a railway carrying goods to and from Lake Nyasa, Nyasaland, and North-Eastern Rhodesia, *viâ* the port of Beira in Portuguese East Africa. The joint consulting engineers, Messrs. Livesey and Henderson and Messrs. Rendel, Palmer and Tritton, chose for its site a point between Sena on the right bank and Mutarara on the left, and the recently completed bridge consists of thirty-three main and six approach spans supported on concrete piers, which are themselves built upon concrete wells sunk in the bed of the river or on mass concrete bases founded upon rock at the river bank. Nineteen of the main spans are on a gradient and the remainder level. Saddle and knuckle type bearings carry the spans, which are each 262ft. 6in. long.

THE LOWER ZAMBESI BRIDGE

Asia.

The fact that the Irrawady bridge at Sagaing, near Mandalay, was opened by the Governor of Burmah on January 2nd, 1934, just brings that structure into this survey. It is nearly ¾ mile long and consists of ten spans, nine of which are 360ft. long and the remaining one 260ft. Its construction was started in 1927, and its cost has been about £1,125,000. It is built as a railway bridge, but on each side there is carried on cantilevers a 12ft. roadway. Messrs. Rendel, Palmer and Tritton were responsible for its design, and supervised the work of building, and Braithwaite and Co. (India), Ltd., were the contractors.



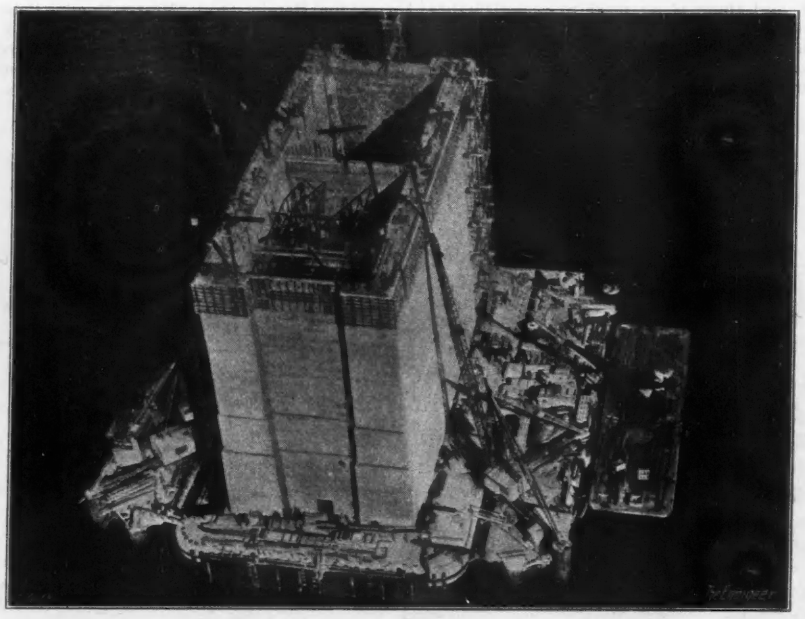
CONTINUOUS TIED ARCH OF LAKE ST. LOUIS BRIDGE

Canada.

Two interesting structures are approaching completion in Canada, at Vancouver and near Montreal, respectively. Following a series of accidents, the steel bridge carrying highway and railway traffic over the Second Narrows of Vancouver Harbour has been reconstructed. The original bridge consisted of timber trestle approaches, four fixed girder spans, and a bascule span of the Strauss overhead type placed towards the southern side of the navigable water. On September 19th, 1930, a 300ft. fixed span was lifted off its supports and pushed into the water, as a result of the rising tide acting on a vessel which had become jammed under the span. For over two years

thereafter, the bridge was left in an incomplete and useless condition. The bridge had been privately built, and the series of accidents culminating in that just recorded, together with the resulting cessation of revenue, resulted eventually in the appointment of a receiver for the owning company. In December, 1932, the Federal Government authorised the Vancouver Harbour Commissioners to acquire the bridge. In the resulting energetic discussion of ways and means by which the bridge might be reconstructed, it was demonstrated that the opening made by the upsetting of the 300ft. fixed span was so situated with respect to navigating conditions as to appeal to all shipping interests as the logical place for the channel. After examining many schemes, the consulting engineers, Monsarrat and Pratley, of Montreal, decided upon the adoption of a span of vertical lift type, with a grouping of piers, which involved the construction of two new ones and the demolition of one old one. The old bascule span, reduced in length by 56ft., was to serve as the south flanking span. As constructed, the new steelwork consists of a 282ft. lifting span and its towers. The span carries the railway track between its main trusses and the highways on cantilevered brackets outside the main trusses. It lifts 117ft. 3in. for normal operation, and can rise 3ft. further as an emergency, giving then a clearance over high water of 143ft. This lift is completed electrically in two minutes. The operating cabin is situated at the centre of the lifting span. Especially in the founding of the piers, considerable difficulties were encountered in building the bridge. There is insufficient space here to deal adequately with the methods by which these difficulties were overcome, and we hope to return to the subject at an early date.

The Lake St. Louis bridge across the St. Lawrence, near Montreal, is an interesting structure, which was completed early in the year. It carries a main road and crosses the river on thirteen piers, the distance between the faces of the extreme piers being 2918·3ft. On each side it is approached by an earth embankment and a concrete viaduct. The steel superstructure for the bridge is mostly of deck type, but modified to conform with the navigation requirements of the Federal Government. It carries a roadway, 27ft. wide between kerbs, and one 4ft. pathway. All the spans are similar, except for three near the south shore over the navigable channel, which are illustrated diagrammatically on page 5. On the north side one of the spans is 231ft. in length instead of 235ft., like the rest, as, if the St. Lawrence Deep Waterway Channel scheme is eventually carried out it will be necessary to install at this point a vertical lifting span. Provision has been made for this possibility in the construction of the piers. The centre distance between trusses is also enlarged over three spans at this point to 31ft. instead of 20ft., in order to provide sufficient clear width for the roadway to pass through the future lift span, as well as to pass through the counterweight towers. The trusses for the special continuous tied arch, illustrated, are also spaced at 31ft. centres, in order that the roadway may pass between them, as well as to give lateral stability. In consequence of this arrangement, two of the intermediate spans are arranged with trusses inclined to one another, so as to conform at both ends to the spacing of the trusses in the adjacent spans. The distinguishing and most interesting feature of the bridge is the continuous tied arch. In the development of its general design many interesting problems were encountered and successfully solved. The steelwork, it will be observed, is continuous over four supports, and gives vertical reactions only, the thrust of the arch ribs being resisted by a bottom tie at the floor level. The top chords of the arch are continuous with those of the anchor spans. Each side span is 235ft. between centres of piers, and the arch span 400ft. The continuous tied arch resembles the simple tied arch, supported on the cantilevered arms of anchor spans, but the top chords at the ends of the arch are not cut after erection, and thus continue to be effective members of the structure, resulting in economy of materials and greater rigidity. In this design, an articulated joint at the point where the bottom tie meets the arch rib becomes unnecessary, which is a great advantage, in view of the complicated details at this point, where provision must also be made for transverse bending moments of considerable magnitude due to wind loads. For calculation of stresses, the arch is assumed to be hinged at the crown, although the joint at this point is actually riveted. The lower chord of the arch rib in the two panels adjacent to the centre line, which is of the lightest practicable section, is designed as an idle member, thus removing one redundancy and greatly facilitating the stress calculations. By assuming a hinge at the top, and by making the lower rib at the centre of the span incapable of transmitting stress, the effective depth of the arch is increased, resulting in a considerable saving in the bottom tie, which is probably sufficient to compensate for the lack of continuity of the crown. For the calculation of reactions the structure has been treated as a girder of variable moment of inertia, continuous over four supports. The influence lines for the reactions have been obtained by the elastic curve method. Owing to the unusual framing of this continuous girder and the consequent great and sudden changes in its moment of inertia, the curves are decidedly irregular and somewhat surprising. The deflections were obtained by a Williot diagram, using sectional areas of members derived from earlier designs.



CENTRE ANCHORAGE FOR SUSPENSION SPANS OF SAN FRANCISCO-OAKLAND BAY BRIDGE

The United States.

One of the major projects now under construction in the United States is the San Francisco–Oakland Bay bridge, the longer, but less grandly conceived of the two great structures which are to be erected at San Francisco, of which the other is the Golden Gate bridge. Work upon the latter has hardly advanced sufficiently far for it to be necessary to make any further reference to it. The total length of the San Francisco-Oakland Bay bridge between approaches and inclusive of the distance across an island situated about midway is 39,785ft., or 7·54 miles, of which 17,546ft. is over water. Its construction is estimated to cost 75 million dollars, and it is planned to finish the work in 1937. In reality it consists of two distinct bridges, one connecting San Francisco to Yerba Buena island, which is the more interesting of the two, and the other connecting the island with the Oakland shore. The first named will consist of two suspension spans, 2310ft. between centres of towers, and four side spans, each 1160ft. long. The two central towers are to be 500ft. high above the water, with foundations carried 15ft. into rock, and the others 475ft. high. These two suspension structures are to be anchored in midstream to a reinforced concrete structure with a height above high water of 235ft. This anchorage will only have to balance horizontal stresses due to live loads, as the dead load stresses on the cables of the two bridges will balance out. At the time the photograph of it reproduced herewith was taken, it had been built up to a height of 152ft. above high water level. Its foundations extend to a depth of 224ft. below the water, and its horizontal section is 197ft. long by 92ft. wide. The anchorage pins will be set 170ft. apart on it. The most important part of the bridge connecting the island to Oakland is cantilever, with a central span of 1400ft. and side spans of 512ft., giving a clearance above high water of 185ft.

The two bridges and the intervening tunnel on Yerba Buena island are designed to carry six lines of traffic on an upper deck and three lines of traffic for omnibuses and lorries and two tracks for electric cars on the lower deck. The tunnel through the island is therefore of very unusual size, with an internal width of 65ft. 6in. and a height of 53ft. The work is being carried out by the Department of Public Works of the State of California, of which Mr. C. H. Purcell is the chief engineer.

Another interesting bridge operation in the United States to which brief reference may be made was that, completed during the year, of providing for the Smithfield Bridge, Pittsburg, a new aluminium floor. This bridge was originally erected in 1882, and widened in 1890. It had a timber decking. For some years its condition had given rise to uneasiness, and in 1932 it was found that urgent repairs were needed. Its state necessitated the limitation of the loads upon it. In October, 1933, the work of renovation was started, and a year later the bridge was reopened for traffic. Prior to the work no vehicles weighing more than 13 tons on four wheels were allowed to use the bridge, and street cars were required to maintain a 50ft. interval. Renovated, and with its new aluminium floor, the bridge can carry 20-ton trucks. The use of aluminium for the flooring reduced the dead load by rather more than 1 ton per lineal foot.

Shipbuilding & Marine Engineering in 1934

No. I.

THE past year saw a marked, though not extensive, improvement in the shipbuilding, ship-repairing, and marine engineering industries of Great Britain and Northern Ireland. Whether that improvement be measured by the flow of new orders, the tonnage begun, launched, or under construction, the outstanding fact is that the amount of mercantile shipbuilding was doubled. Whereas in 1933 work proceeded on about a quarter of a million tons, throughout the past year the corresponding figure was generally round about the half-million mark. Alongside the increase in mercantile tonnage, there was a noteworthy increase also in naval work, some reference to which is made in our naval survey. At the end of 1934 there were about fifty naval vessels under construction or on order at our private shipbuilding yards, eight of which are being constructed for foreign Governments. The Royal Dockyards were also fairly well occupied. The increased volume of Admiralty work materially helped to increase employment, and it may be said that at the end of the year one berth in every five was engaged on naval construction.

Satisfactory as the improvement was, many shipbuilding districts were at the year's end in need of work, for the increase was not well divided between the different districts. The two leading Belfast firms, which two years ago had practically no orders on their books, have now on hand a succession which will ensure considerable activity for some time to come. On the Clyde the 1934 output was no less than sixty-seven ships, representing well over a quarter of a million tons, practically half the national output, and a quarter of the world's total tonnage. Both at Birkenhead and Barrow there was a fair amount of naval and mercantile work, while towards the end of the year indications were not wanting that the North-East Coast will in the present year play a more important part in the construction of new tramp tonnage and passenger and cargo liner construction. The half-million tons of merchant shipbuilding we have referred to is, it must be remembered, but one-third of the 1929–30 volume of merchant tonnage, and in spite of the fact that in 1934 no less than 137 berths of a million tons annual building capacity had been scrapped under the industry's own rationalisation scheme, 75 per cent. of the remaining berths were unoccupied in December last, and nearly half the men were unemployed, despite the fact that since 1923 the number registered as following the industry has been almost halved.

Although the amount of British naval and mercantile work increased throughout the year there was

little improvement in the amount of tonnage built for export, the total value of such vessels only amounting to about £1,500,000, as against £10,000,000 in 1931. The past year was in many ways an anxious one for shipbuilders. During the summer and autumn the flow of orders was not maintained, and the percentage of berths occupied fell from 29 per cent. in June to 23 per cent. in September, with a slight setback in employment during the following two months. In November and December, however, a number of new cargo steamers, and cargo and passenger liners were ordered. The placing of these orders was without doubt influenced to some extent by the Government schemes for the assistance of tramp shipping, as greater confidence has been created among shipowners by the measures taken by the Government to help British shipping in its fight against subsidised foreign competition. Ship-repairing also benefited to some extent, as several shipowners sent ships which had been laid up for long periods to repair establishments for reconditioning, so that they might be available for trading under the new conditions. Should the Government's "scrap and build" scheme be taken full advantage of by owners of cargo ships, the better position which the industry has enjoyed during 1934 will at least be maintained. Speaking generally, there is no doubt that the new tramp ships recently designed and built in British yards, no matter whether propelled by steam or oil engine machinery, are vastly superior to their predecessors, and are able to pay their way, whereas vessels built even a few years ago can often only be run at a loss. It is now recognised by shipowners that recent improvements made in both hull form and propelling machinery, largely the result of careful experiment and tank research, have made it possible for British shipbuilders to offer modern cargo ships, which will carry twice as much freight-paying cargo for each ton of fuel consumed as can be carried by the cargo vessels which were constructed eight to ten years ago. The increased output in motor ship tonnage is shown in the accompanying graph, Fig. 1.

As regards labour, although there were some differences of opinion between employers and men concerning the future training of welding operatives, and general level of wages, the conciliation machinery provided in the industry worked well, and the year passed, as did 1933, with a complete absence of serious labour disputes.

Dealing with the more theoretical and research side of naval architecture and shipbuilding, we may recall the valuable Summer Meeting of the Institution of Naval Architects, which was supported by the British Government and was specially devoted to the various aspects of experimental tank work. It did much to unify the nomenclature and to co-ordinate the work of the various national and private testing establishments. Last year's meeting was the direct outcome of a conference of tank experimenters which took place in Holland the previous year under the chairmanship of Mr. John de Meo.

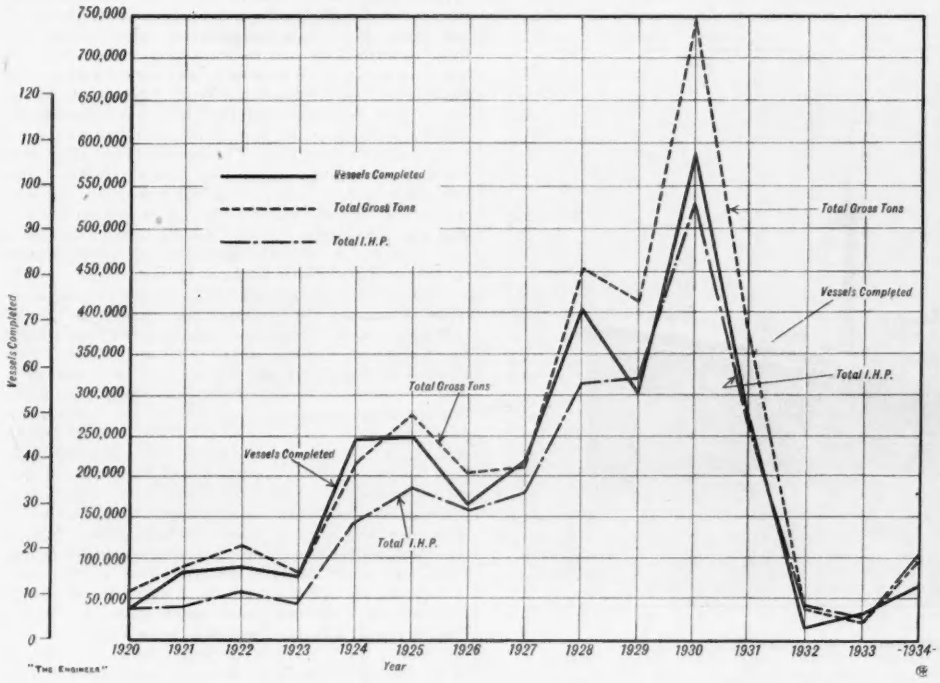


FIG. 1—OUTPUT OF MOTOR SHIP TONNAGE

Some 1934 Outputs.

The returns we have received from the various shipbuilding centres all indicate the improved position of the industry, to which we have already referred. The largest Clyde output was that of John Brown and Co., Ltd., with six vessels aggregating 87,590 gross tons and machinery of 85,170 s.h.p. total. The latter figure does not include any portion of the probable 200,000 s.h.p. for the "Queen Mary," which machinery was not completed last year. The figures above given include 5790 tons displacement and 75,770 s.h.p. on account of Admiralty work. The next largest Clyde output was that of Lithgows Ltd., of Port-Glasgow, which firm completed nine cargo carriers, totalling 50,905 tons. Another large output was that of Alexander Stephen and Sons, Ltd., of Linthouse, with four vessels and small craft aggregating 22,153 tons and engines of 11,380 i.h.p. for four ships. An output of almost similar tonnage was that of Harland and Wolff, Ltd., of Govan, which launched five vessels of 20,068 tons and completed at its Finnieston works engines of 22,700 i.h.p. total. Other mercantile outputs were those of D. and W. Henderson, Ltd., of Partick, with four ships totalling 17,474 tons and engines of 7000 i.h.p. total. At Scotstoun the Blytheswood Shipbuilding Company, Ltd., launched two oil tankers totalling 8675 tons. Barclay, Curle and Co., Ltd., of Whiteinch, launched three ships and small craft of 8243 tons, and completed engines aggregating 7400 i.h.p., and supplied seven additional boilers totalling 7920 i.h.p. Outputs which represented some Admiralty work were made by William Denny and Brothers, Ltd., of Dumbarton, by whom eight ships and small craft were constructed, including two destroyers, aggregating 7248 tons with engines of 93,500 s.h.p. total. At Scotstoun Yarrow and Co., Ltd., launched the British flotilla leader H.M.S. "Faulknor" and finished engines of 66,000 s.h.p. total. The Fairfield Shipbuilding and Engineering Company, Ltd., completed at Govan two vessels of 11,220 tons and engines of 46,200 s.h.p., while at Greenock Scott's Shipbuilding and Engineering Company, Ltd., finished four ships, three for the Admiralty, totalling 10,761 tons, with machinery of about 138,300 s.h.p. Among the engine outputs were those of David Rowan and Co., Ltd., of 15,600 h.p. for eight ships, while the same firm built eleven additional boilers of 6400 i.h.p. total and completed four sets of Rowan-Gotaverken turbo-compressors. John G. Kincaid, of Greenock, completed 37,580 i.h.p. for seven ships, which included eight small British Kromhout engines totalling 380 i.h.p. British Auxiliaries, Ltd., of Govan, completed six sets of British Polar engines totalling 4735 i.h.p. Among the builders of smaller marine engines we may mention Gleniffer Engines, Ltd., of Anniesland, with 8252 i.h.p., and the Bergius Company, Ltd., of Glasgow, with engines of 7806 i.h.p. At Southampton the Parsons Oil Engine Company, Ltd., completed small marine engines aggregating 3500 i.h.p. total. Turning to other centres on the Forth, the Burntisland Shipbuilding Company, Ltd., completed six ships totalling 5813 tons, while at Leith Henry Robb, Ltd., finished twelve vessels aggregating 3151 tons.

At Barrow-in-Furness Vickers-Armstrongs launched eight naval ships and one passenger liner totalling 36,578 tons, and completed machinery of 102,900 s.h.p. total; while at Birkenhead Cammell Laird and Co., Ltd., launched nine mercantile ships and small craft and four naval vessels aggregating 22,975 tons and representing 95,700 s.h.p. of machinery. On the Tyne Swan, Hunter and Wigham Richardson, Ltd., launched a total of 35,587 tons, which included four British ships of 16,583 gross tons and 20,250 h.p. and three ships for foreign owners of 8414 tons total and 7200 h.p. Three British naval vessels were also launched representing 10,590 tons displacement and 144,000 h.p. A number of Bauer-Wach low-pressure turbine and triple-expansion installations were also completed, totalling about 8310 h.p. During the year the firm opened a new graving dock at Wallsend. It has a length of 570ft., with a breadth of 80ft., and is fully equipped with electric cranes.

At St. Peter's Works, Newcastle-upon-Tyne, R. and W. Hawthorn, Leslie and Co., Ltd., constructed 95,000 equivalent i.h.p. of machinery, which included two 3500 s.h.p. oil engines for Anglo-Saxon oil tankers. At Wallsend the Parsons Marine Steam Turbine Company completed 87,000 h.p. of geared turbine machinery, and cut gearing for clients. At the Wallsend Slipway and Engineering Company, Ltd., Wallsend, naval machinery for three ships was completed totalling 160,000 equivalent i.h.p., while the firm supplied 127 oil-burning installations, representing 203,631 i.h.p., and constructed an improved Scotch boiler of the Howden-Johnson type. Two sets of turbine machinery were also reconditioned. At the Wallsend and Sunderland works of the North-Eastern Marine Engineering Company, Ltd., twelve triple-expansion steam engines aggregating 14,986 i.h.p. were completed, with 1248 i.h.p. of additional boilers, while marine superheaters totalling 99,770 i.h.p. for 106 boilers were supplied. At West Hartlepool the Central Marine Engine Works completed two sets of triple-expansion engines for paddle steamers totalling 2470 i.h.p., and supplied a large amount of auxiliary machinery and fittings.

The Belfast returns of Harland and Wolff, Ltd., show a total of six motor vessels of 50,210 tons total launched with oil engines of 63,240 h.p., added to which two sets of geared turbine machinery with Johnson boilers were completed for the Royal Mail liners "Asturias" and "Alcantaria." At the London establishment craft of 3000 tons was completed, which, together with the Glasgow outputs previously referred to, gives a grand total for the Harland and Wolff establishments of eleven ships, representing 73,275 tons and engines of 85,940 h.p., to which about 40,000 s.h.p. of steam machinery must be added. At the Belfast yard of

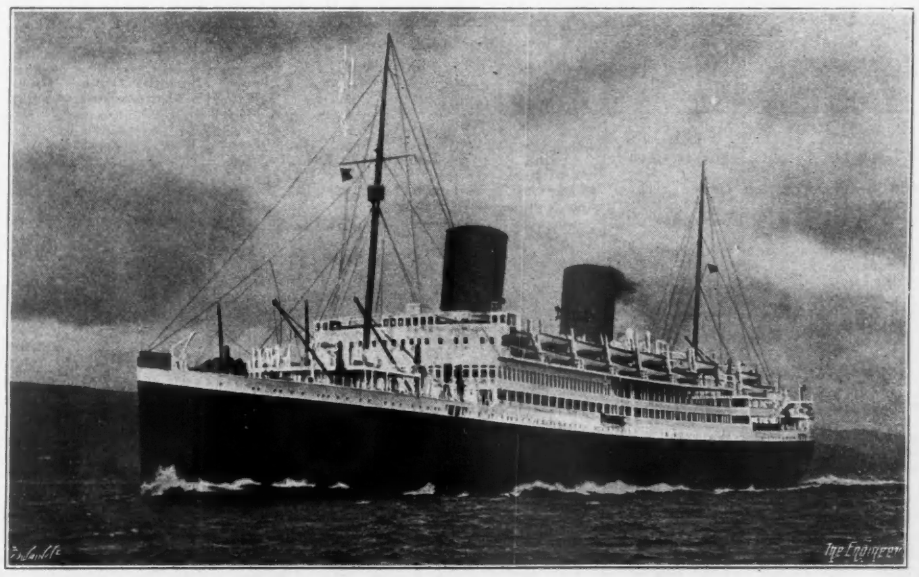


FIG. 2—R.M.S. "ASTURIAS"

Workman, Clark and Co., Ltd., four ships, totalling 37,200 tons, were launched and engines of 36,900 h.p. installed, 13,000 h.p. of which was built at Winterthur. The firm also installed 41,445 h.p. of exhaust turbo-electric equipment by Metropolitan-Vickers in four cargo ships of the City Line.

The World's Two Largest Liners.

The outstanding event in British shipbuilding during 1934 was undoubtedly the launching of the 73,000 gross tons Cunard White Star liner "Queen Mary" from John Brown's Clydebank yard on Wednesday, September 26th, by Her Majesty the Queen. In two special articles which appeared in our issues of September 28th and October 5th, 1934, we described the building and launching of this great ship and briefly referred to her propelling machinery. In one of to-day's Supplements we are enabled, by the courtesy of the builders, to reproduce a recent photograph of the ship as she now appears in the fitting-out basin. In a Leading Article of October 5th we congratulated both the builders and the owners on a truly great launch, and a ship of outstanding design. In the latter months of the year good progress was made with the completion of the ship, and the work done included the removal of the special hull strengthening used for launching, progress on the hull, and the installation of the main propelling and auxiliary machinery, which is well advanced in construction.

Considerable interest attaches to the progress of the French Line 79,000 gross ton liner "Normandie." A recent view taken at the fitting-out basin of her builders' yard at St. Nazaire is reproduced in one of our Supplements. The machinery and the hull structure, also cabins and public rooms, are well advanced and it is hoped that the ship will be completed in the early months of this year. On the machinery side, her boiler installation has been tested, both cold and under steam, all the four main turbo-generators, the seven auxiliary dynamo sets, and the main propelling motors have been completed. Some of the generating sets are already in use for lighting and power purposes, and two of the main generator sets have been tested under steam. Work is now proceeding on the switchboards and the high-pressure cables, and it is fully expected that everything in the engine-room will be completed by February next, ready for trials in April or May.

Some British Liners and Cargo Ships.

Any reference to British liners in 1934 would not be complete without recording the fine performance of the Canadian Pacific 42,348 gross ton passenger steamer "Empress of Britain" in August last, when, on her forty-sixth voyage on the east-bound passage she made the crossing between Father Point and Cherbourg in 4 days, 6 h. 58 min., corresponding to an average speed of 25·08 knots. Her daily fuel consumption for the voyage in question was 377 tons of oil fuel for all purposes, or 0·57 lb. per s.h.p.-hour. The steam conditions were 400 lb. pressure, 730 deg. Fah. total temperature, and a vacuum of 29in. This fine ship, both on Atlantic crossings and world cruises, retains the distinction of being the most economical large liner of her class afloat.

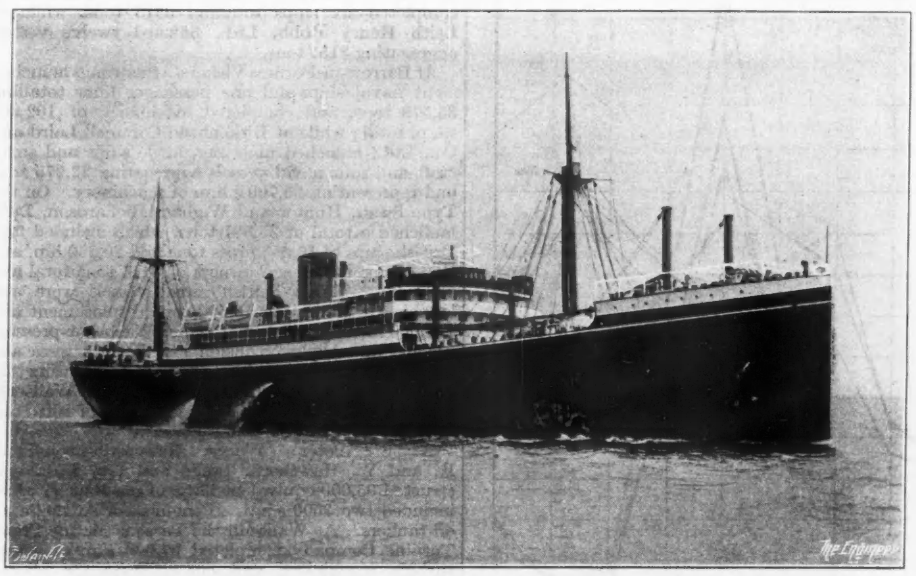


FIG. 3—THE MOTOR CARGO SHIP "WAIWERA"

Considerable interest attached to the conversion of the Royal Mail Line motor ships "Asturias" and "Alcantara" to steam by the installation of modern turbine machinery with Johnson oil-fired boilers. A full account of the machinery of the "Asturias"—Fig. 2—was given in our issue of October 12th, together with some trial figures. The following particulars of her first voyage are of interest:—The "Asturias" left Southampton on Saturday, October 20th, on her first voyage to Buenos Aires, with her new machinery working without a hitch. She arrived at Lisbon to schedule on the 23rd, where fuelling was carried out, leaving on the same day for the cross-Atlantic run to Rio de Janeiro. A day or two before arrival at Rio a wireless message was sent to the ship asking that arrival should be made, if possible, four hours ahead of the schedule time, owing to extra cargo commitments, and the vessel easily complied with this request and docked at the time set. Leaving Rio to schedule, with calls made at Santos and Montevideo, Buenos Aires was reached on November 6th to time, good weather conditions having been experienced throughout the outward passage and steam easily maintained. The Johnson boilers, the smoke and dirt collectors, and the Parsons turbines, with all auxiliary machinery, gave every satisfaction, and functioned easily and efficiently. The vessel was at Buenos Aires three days only. Leaving on November 9th for the homeward run, which was accomplished as successfully as that outward, she arrived at Southampton on November 26th, having taken thirty-four days for the round trip, with a call at six intermediate ports each way. The average speed for the round voyage was over 17½ knots, the Transatlantic runs Lisbon–Rio and Rio–Lisbon being accomplished at a little over 18 knots. Her sister ship the "Alcantara" is now at Belfast, where her new steam machinery is being installed.

The principal large cargo liners constructed during the year were fast refrigerated motor ships, with limited passenger accommodation, specially designed for Empire food services. A typical ship is the Shaw, Savill and Albion cargo liner "Waiwera"—Fig. 3—particulars of which are given in the accompanying table. She was fully described in our issue of September 7th. A sister ship, the "Waipawa," was completed at the Belfast yard of Harland and Wolff, Ltd., while at the same firm's Govan yard on the Clyde the "Wairangi" was launched and her machinery installed ready for trials early in the year. The first of three Blue Star Line Empire cargo ships, the "Imperial Star," ran her trials just before the end of last year, and she will be shortly followed by the "New Zealand Star" and the "Australia" Star," which is to be launched in January. All these ships were built and engined by Harland and Wolff, Ltd., at Belfast.

Two other outstanding cargo ships of the same class, designed for Australasian trade were the "Dorset" and "Durham," which were constructed by Workman, Clark (1928), Ltd., at Belfast. Particulars of these ships are given in the table herewith. The "Dorset" is illustrated in one of to-day's Supplements, and a description of her machinery, which was supplied by Sulzer Brothers, of Winterthur, was given in our issue for August 31st. This installation was noteworthy on account of the very low fuel consumption, 0·33 lb. per s.h.p.-hour, which was obtained on the trials. The engines of the "Durham" were described in our issue of July 13th. Among the other motor ships and tankers enumerated in our table, we may specially mention the motor vessel "Yunnan," a view of which is reproduced in the Supplement. She was built and engined by Scott's Shipbuilding and Engineering Company, Ltd., of Greenock, for the China service of the China Navigation Company, and is a passenger and cargo ship of 3000 gross tons. Among the cargo steamers built during the year for Chinese owners we may mention the four ships ordered by the Chinese Government Purchasing Commission for the coastal services in the Far East of the China Merchants' Steam Navigation Company. Two ships, the "Hai Yuan" and "Hai Li," were built and engined at the Neptune Yard of Swan, Hunter and Wigham Richardson, Ltd., of Newcastle-upon-Tyne, while two, the "Hai Yeng" and "Hai Chen," were constructed and engined by Barclay Curle and Co., Ltd., on the Clyde. They all have an overall length of 325ft., a moulded breadth of 47ft., and a moulded depth to the upper deck of 25ft., with a deadweight carrying capacity of 3200 tons, a loaded draught of 17ft. 6in., and a measurement of 3500 gross tons. Provision is made for the carriage of first, second, and third-class passengers, and unberthed passengers. The propelling machinery comprises one set of triple-expansion engines, with two Scotch boilers, which are equipped with superheaters and work under the Howden system of forced draught. The whole of the propelling machinery and auxiliary equipment was designed for high economy in fuel consumption. The ships were built under the supervision of Sir J. H. Biles and Co., of London, to plans and specification prepared by Mr. T. M. Wu and Captain F. Scurr, the owner's representatives.

The Channel Train Ferries.

During the year Swan, Hunter and Wigham Richardson, Ltd., launched and completed two of the three cross-Channel train ferries, the "Twicken-

British Built Motor Ships and Marine Oil Engines, 1934.

Owners.	Name of ship.	Type and speed.	Shipbuilder.	Hull particulars.				Type of propelling machinery.	Main engine particulars.			
				Length B.P.	Breadth m'lded.	Depth m'lded.	Gross tonnage.		Cyl. bore.	Stroke.	R.p.m.	Total b.h.p.
				Feet.	Feet.	Feet.			mm. & in.	mm. & in.		
Coast Lines, Ltd.	Atlantic Coast ..	11-knot motor coaster	Henry Robb and Co., Ltd. ..	230	35	21	889	Twin British Polar 5-cyl., 2-stroke, S.A.	340	570	220	1,250
Federal Steam Navigation Company, Ltd.	Dorset	16-kt. refrig. cargo & pass.	Workman, Clark (1928), Ltd.	490	68·3	47·16	10,900	Twin Sulzer, 8-cyl., 2-stroke, S.A.	720	1,250	126	11,000
	Durham	" "	" " "	490	68·3	47·16	10,900	Twin Workman Clark-Sulzer, 8-cyl., 2-stroke, S.A.	720	1,250	126	11,000
Sir Wm. Reardon Smith and Sons	Houston City ..	Cargo	Furness Shipbuilding Co., Ltd.	440	56	37·1	6,200	Single Doxford, 4-cyl., opposed piston	600	2,320 comb'd	95	3,200
Blue Star Line, Ltd.	Imperial Star ..	16-kt. refrig. cargo & pass.	Harland and Wolff, Ltd. ..	516·75	70	43	10,670	Twin Harland-B. & W., 10-cyl., 4-stroke, S.A., pres.-charged	740	1,500	112	12,000
Andrew Weir and Co., Ltd.	Incomati ..	15-kt. refrigerated cargo & pass.	Workman, Clark (1928), Ltd.	435	57	37	7,370	Twin Doxford opposed piston	600	1,800 comb'd	115	5,750
	Inchanga ..						7,100	Twin Workman Clark Sulzer	600	1,040	135	4,800
	Isipingo ..						7,100	Twin Workman Clark Sulzer	600	1,040	135	4,800
David McBrayne, Ltd. ..	Loch Nevis ..	Tourist passenger	W. Denny and Bros., Ltd. ..	175	31	10·6	550	Twin 6-cyl., 940-kW, Davy Paxman-G.E.C. elec. trans.	13in.	16in.	500	1,300
Gow, Harrison and Co., Ltd.	Valverda	Molasses tanker	William Hamilton and Co., Ltd.	475	63·25	35	8,807	Twin Kincaid-B. & W., 6-cyl., 4-stroke, S.A.	630	1,300	110	3,160
Shaw, Savill & Albion Co., Ltd.	Waiwera ..	16-kt. refrig. cargo & pass.	Harland and Wolff, Ltd. ..	515	70	43·3	10,780	Twin Harland-B. & W., 10-cyl., 4-stroke, S.A., pres.-charged	740	1,500	112	12,000
	Waipawa ..			515	70	43·3	10,780		740	1,500	112	12,000
China Navigation Co., Ltd.	Yunnan	Cargo & pass.	Scott's Shipbuilding and Engineering Co., Ltd.	230	44·2	21·6	3,000	Single Scott, 5-cyl., 2-stroke, S.A.	22in.	36in.	116	1,250

ham Ferry," the "Hampton Ferry," and the "Shepperton Ferry," which have been specially designed under the supervision of Sir Westcott Abell for the Southern Railway Company's cross-Channel service between Dover and Dunkerque. The first of these ships, the "Twickenham Ferry," is illustrated on page 14. The ships have a length of 360ft., with a breadth of over 60ft., and are constructed to carry a train of twelve sleeping cars or forty loaded goods wagons on four lines of rails. A high standard of passenger accommodation has been provided.

The Taylor stoker-fired Yarrow boilers and the Parsons geared turbine machinery for these ships were fully described in THE ENGINEER of April 20th. Towards the end of the year the 92ft. wide caisson built by the Furness Shipbuilding Company, Ltd., for the Dover train ferry dock was put into position, and pumping operations were begun. The dock is expected to be ready for service early in the year.

Some Other Ferry Boats.

At Birkenhead Cammell Laird and Co., Ltd., completed the Mersey ferry steamer "Royal Daffodil II" for the Ferries Department of the Borough of Wallasey. She has a length of 150ft., with a beam of 46ft., and a designed speed of 12 knots, and is propelled by twin-screw, triple-expansion engines, taking steam from three single-ended boilers.

Two paddle steamer ferry boats, the "Wingfield Castle" and "Tattershall Castle," were built by William Gray and Co., Ltd., and engined by the Central Marine Engine Works, of West Hartlepool, for the L.N.E.R. and Hull Corporation new ferry service between Hull and New Holland, in North Lincolnshire. On the upper reaches of the Clyde three small oil-engine propelled ferry boats were built by Barclay Curle and Co., Ltd., and engined by Gleniffer Engines, Ltd., of Glasgow.

Cross-Channel and River Estuary Steamers.

Among the ships which were launched late in 1933 and finished in the early part of last year was the L.M.S. Railway Company's Larne-Stranraer steamer "Princess Maud"—see Fig. 5—which is doubly noteworthy as being the first mail steamer of her type to be equipped with all-mechanical coal-fired boilers, and to have her public rooms and cabins protected from fire by a Grinnell sprinkler installation. She was built by William Denny and Brothers, of Dumbarton, and her machinery comprises four 225 lb. pressure Babcock and Wilcox water-tube boilers, which are fitted with mechanical stokers of the Erith-Roe pattern, and supply steam to her geared turbine machinery. Another interesting Denny-built steamer is the "Caledonia"—see page 14—which was specially designed for the Ardrossan and Arran service of the London, Midland and Scottish Railway Company. She has a length of 222ft., a beam of 30ft., and a depth of 10ft. 3in. to the main deck.

While a few of the latest turbine river steamers have been designed with two masts, the "Caledonia" and her consort, the "Mercury," constructed and delivered by the Fairfield Shipbuilding and Engineering Company, Ltd., are the first paddle steamers on the river to be so fitted. These vessels are capable of carrying about 1300 passengers. On the "Caledonia" a deck shelter or observation room for first-class passengers is situated on a house on the promenade deck aft, a similar shelter being fitted on the same deck forward for third-class passengers. The tops of these houses form passenger promenades. Dining saloons for first and third-class passengers are provided.

The "Caledonia" is propelled by paddle wheels fitted with steel feathering floats and driven by a three-crank, triple-expansion, diagonal, surface condensing engine, running at 55 r.p.m. Steam is supplied by two cylindrical Navy-type boilers, each having two corrugated furnaces. The working pressure is 200 lb., and the boilers are arranged for burning coal under the closed stokehold system of forced draught.

Another outstanding cross-Channel steamer of the year was the "Mona's Queen"—Fig. 4—constructed by Cammell Laird and Co., Ltd., at Birkenhead, for the Isle of Man Steam Packet Company for the Liverpool-Douglas service. She has a length of 336ft., a beam of 48ft., and a depth of 26ft., with a measurement of 2736 gross tons and a service speed of 21 knots. Her propelling machinery comprises two sets of Parsons single-reduction geared turbines, taking steam from three oil-fired Babcock water-tube boilers, and on her trials a speed of 22 knots was recorded. The same builders also completed the "Great Western," a passenger and cattle boat for the Great Western Railway Company, which is a 14-knot ship for the Fishguard-Waterford service. This ship is fitted with Babcock boilers and Erith-Roe mechanical stokers.

An interesting foreign-built motor ship, which is reported to be the fastest motor vessel in the world, is the Belgian State Marine Department's new cross-Channel motor ship "Prince Baudouin," which was commissioned on the company's Ostend–Dover service in August last. A view of the ship taken at Dover is reproduced on page 14. She was ordered in 1931 from the Société Anonyme John Cockerill, and was built at the firm's shipyard at Hoboken, her engines being constructed at the Seraing works. She is designed for first and second-class passengers, and has a length of 370ft., with a measurement of about 3300 gross tons. She is an open-shelter-deck vessel, and new features of design include a streamlined form of superstructure, a shortened funnel, and low masts in order to reduce wind resistance. The propelling machinery comprises a twin-screw arrangement of Cockerill-Sulzer oil engines, with a total maximum designed output of 17,000 s.h.p., and a service output of 15,000 s.h.p. They are twelve-cylinder units, with cylinders having a bore of 580 mm., or nearly 22⅞in., and a stroke of 840 mm., or 33 1/16 in. The auxiliary engines, which were supplied by Sulzer Brothers, of Winterthur, are eight-cylinder units operating on the four-stroke cycle. A feature of the engine-room design is the special welded seating for the engines. On her trials the ship attained a speed of 25¼ knots, and her service speed is about 23·5 knots.

Electrically-Propelled Vessels.

In addition to the large electric propulsion equipment for the French liner "Normandie," to which we have already referred, the past year was noteworthy for the commissioning of several electrically propelled ships and the ordering of others. Early in the year William Denny and Brothers, Ltd., of Dumbarton, designed and completed two oil-electric paddle ferry boats, the "Robert the Bruce" and the "Queen Margaret," for the passenger and motor vehicle traffic between North and South Queensferry on the Firth of Forth. The "Queen Margaret" is illustrated in Fig. 6, and a complete description of these ships will be found in our issue of March 9th. They have a length of 149ft., a beam of 28ft., and a depth of 7ft. 10in., with a breadth over sponsons of 47ft. 8in. The Davey-Paxman Metropolitan-Vickers propelling machinery comprises two 200 b.h.p., 750 r.p.m., eight-cylinder oil engines, with cylinders 6½in. diameter and 10in. stroke, coupled direct to main and auxiliary generators, which supply current to two 270 r.p.m. propelling motors, each of which is coupled to one paddle shaft through a Bibby coupling and chain reduction gearing driving the paddle wheels at about 45 r.p.m. at full power, corresponding to a speed of about 10 knots. The ferry boats are of the side loading type, and have given excellent service since they were commissioned in March last.

Another Denny electrically propelled ship is the "Lochnevis," which was specially built for the Mallaig-Kyle-Portree Western Isles service of David Macbrayne (1928), Ltd. She is designed to carry over 700 passengers, and her principal particulars are given in the accompanying table. She was built to full Board of Trade requirements under British Corporation Survey, and has well-arranged passenger accommodation for both first and third-class passengers. A feature of the lay-out is the large covered-in passenger shelter on the promenade deck amidships. The "Lochnevis" is propelled by two electric motors, each coupled to its propeller through a line of shafting. The two Davey-Paxman-G.E.C. generating sets and the propelling motors are arranged in separate compartments. The whole of the electrical equipment was designed and supplied by the General Electric Company, Ltd., of Great Britain.

Early in November the London and North-Eastern Railway Company placed an order with A. and J. Inglis, Ltd., of Pointhouse, Glasgow, for an oil-electric paddle ship for its Clyde passenger services. The whole of the propelling and auxiliary machinery will be supplied and erected by the English Electric Company, Ltd., of Rugby and Stafford. The ship will have a length of about 215ft., with a beam of 27ft. 6in., and she will be designed for a speed of about 17 knots. The motor will be directly coupled to the paddle wheel shaft, and will be the first of this

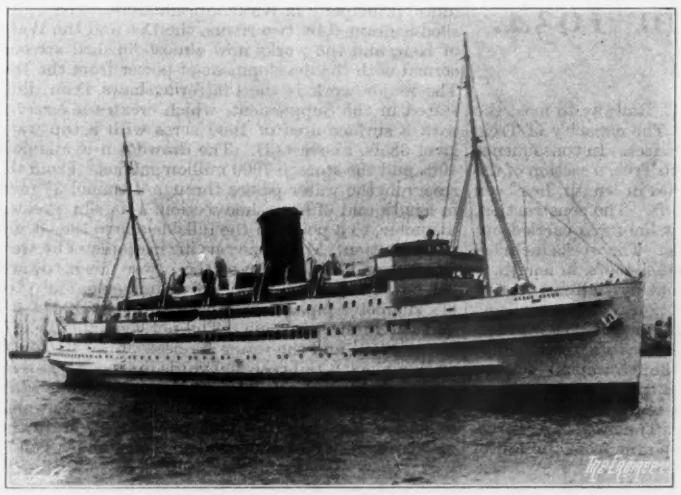


FIG. 4—ISLE OF MAN TOURIST STEAMER "MONA'S QUEEN"

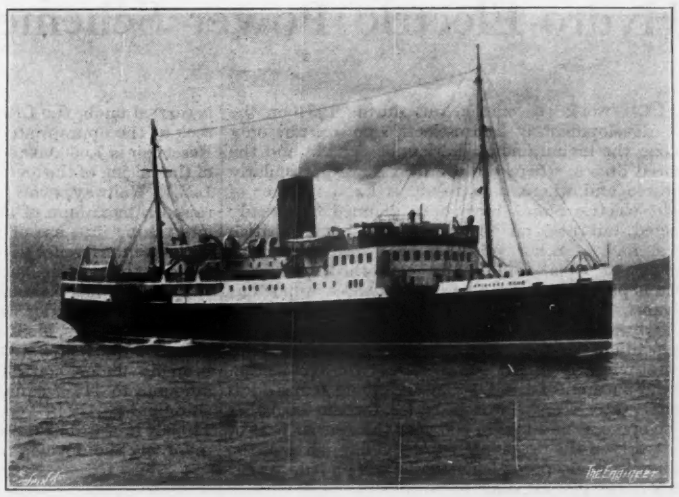


FIG. 5—L.M.S. LARNE-STRANRAER STEAMER "PRINCESS MAUD"

FIG. 6—ELECTRICALLY-PROPELLED PASSENGER AND MOTOR FERRY "QUEEN MARGARET"

type for Clyde passenger service. At the English Electric Company's works the complete equipment was finished for an oil-electric tug designed for Thames service.

In last year's article we referred to the success of the Crossley-B.T.H. oil-electric bridge-controlled propelling equipment, supplied for the Hong Kong Kowloon double-ended ferry boat "Electric Star." Following the success of this ship, the British Thomson-Houston Company, Ltd., of Rugby, has recently received an order to convert the Port Jackson and Manly Steamship Company's double-ended ferry boat "Bellubera" to oil-electric drive. This ship is one of six steam ferry vessels running in Sydney Harbour. The new machinery will comprise four Harland-B. & W., five-cylinder, 600 r.p.m., two-stroke oil engines, each with a designed output of 400 to 450 b.h.p., which will be coupled to B.T.H. D.C. generators, with a designed output of 320 kW. The four propelling motors will each have a designed rating of 615 s.h.p. at 790 r.p.m., and will be coupled to the propeller shaft through two single-reduction double-helical gears, for a propeller speed of 158 r.p.m. The auxiliary equipment will comprise Michell thrust blocks and oil pumps and coolers, auxiliary electrical gear, and two bridge control stations.

(To be continued.)

Hydro-Electric Power Schemes in 1934.

MUCH work was carried out during 1934 on the development of hydro-electric power, not only among the mountainous districts of Canada and the United States, where the conditions are particularly suitable and where, as a result, a large number of hydro-electric plants have been planned or already erected, but also on the Continent, in the British Isles, and in other parts of the world. In fact, as far as this country is concerned, the year 1934 is particularly notable in that three important schemes—or, to be more exact, stages in those schemes—were brought to completion. The Tummel development of the Grampian scheme was brought into operation early in the summer. By the completion in the autumn of the Laggan and Treig dams additional water storage was provided for the Lochaber development, and late in the year the greater part of the work on the development of the first stage of the Galloway water power scheme was completed, so that early in the present year the power stations at Glenlee and Tongland will begin to supply current to the grid. Abroad work was continued upon a number of interesting schemes, of which we mention only a few in this article.

The British Isles.

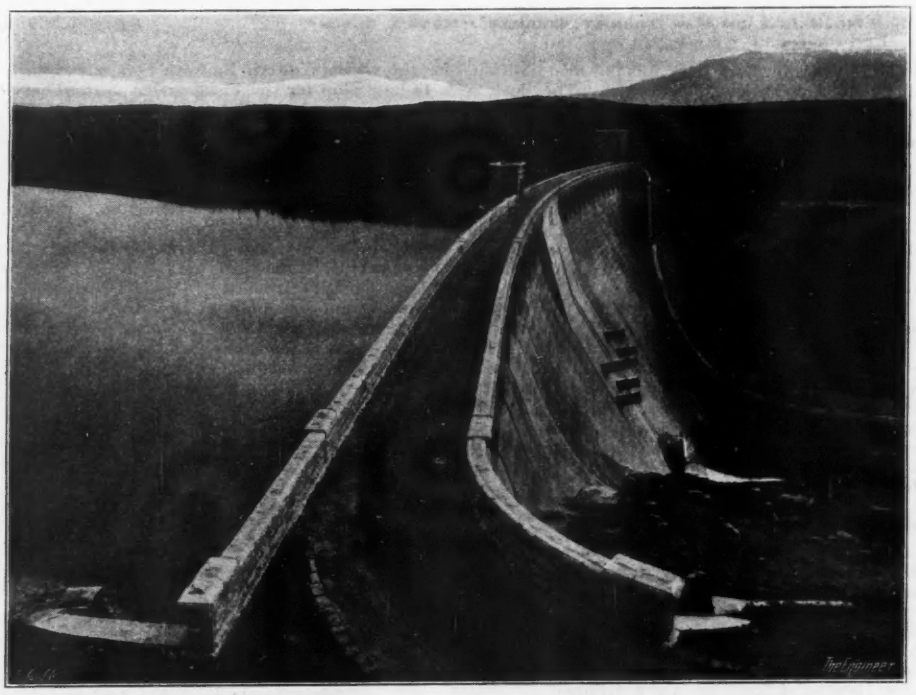
Lochaber.—The Lochaber power scheme, it will be remembered, makes use of a catchment area to the north-east of Ben Nevis in Inverness-shire and supplies water through a tunnel driven under the mountain from Loch Treig to the power-house of the British Aluminium Company, Ltd., at Fort William. When the whole scheme, which is being carried out in three stages, is completed it will be possible to generate over 100,000 h.p. continuously. The first stage works, completed in 1930, comprised the driving of the tunnel mentioned and the construction of the power-house and pipe lines. Further works, bringing under control the waters of the river Spean, have now been completed and comprise the second stage.

A dam has been built across the river Spean at a point about 1 mile above the London and North-Eastern Railway station at Tulloch, on the West Highland branch. The dam, which is illustrated in a Supplement to this issue and by an engraving on this page, is built of mass concrete and is of gravity section, curved in plan, with a length of 700ft. and a height of 170ft. from foundation to crest of spill weir. It is founded on granite rock throughout. A 12ft. road, carried on piers and arches, crosses the dam. The overflow water passes the dam by means of a spillway and there are in addition six syphons in the centre portion of the dam, each with a capacity of 600 cusecs. There is also a discharge culvert 6ft. in diameter for drawing down the water in the reservoir. This culvert has a capacity of 1200 cusecs and is controlled by a needle valve on the downstream side and a roller gate on the upstream side. The effect of the dam is to flood the river Spean as far as Loch Laggan, and by dredging the river for a length of 2 miles below Loch Laggan the water of that reservoir can be used to a depth of 16ft. for storage purposes. The quantity of water contained in the reservoir is 1,500,000,000 cubic feet. Beginning at the Laggan dam a tunnel provided with a mechanically operated control gate has been driven through the shoulder of the hill lying between the river Spean and Loch Treig. The tunnel is 2¾ miles long and is of horseshoe section, having an average equivalent diameter of 14ft. 5in. It is lined throughout with mass concrete. Three streams which cross the line of the tunnel are tapped by means of dams forming intake chambers and the water passes through short lengths of conduit to vertical shafts leading to the tunnel. The tunnel discharges near the north end of Loch Treig, the level of which is being raised 35ft. by the construction of another dam across the river Treig. This dam, illustrated in the Supplement, is of the core wall and embankment type. The core wall, which is of concrete, is 700ft. long and was taken down as much as 100ft. below the bed of the river to meet the rock foundation. Above the bed of the river the core wall is supported by an earth bank with pitching on the upstream side and rock fill with reinforced concrete slab on the downstream side. The overflow from the reservoir passes directly over the dam. The core wall is carried under the L. and N.E. Railway to meet the rock at the appropriate level. The capacity of Treig Reservoir is 7,650,000,000 cubic feet. In consequence of the raising of the level of Loch Treig a section of the L.N.E. Railway, nearly 1½ miles in length, has been raised a maximum of about 40ft. The construction, and taking into use of the new line, was carried out without interference with traffic. The works included some heavy cuttings and a tunnel 450ft. in length.

The work has been carried out by Balfour, Beatty and Co., Ltd., under the direction of the consulting engineers, Messrs. Meik and Halcrow, of Westminster.

Grampian Power Scheme.—The total area to be brought under control by the Grampian scheme amounts to 417·7 square miles, partly in Inverness-shire and partly in Perthshire, and eventually about 110,000 h.p. will be developed. The first stage works, involving the development of power from the fall of water from Loch Ericht into Loch Rannoch, were completed in 1930. The year 1934 saw the completion of another stage—the Tummel development—which increased the catchment area utilised to 209 square miles. This development brings under control the waters running into Loch Rannoch, including those already developing power in the first stage works. A control weir with three gates, each 40ft. wide by 11ft. high, with a sill level at 661ft. above O.D., has been built a short distance downstream of the outlet of the river from the Loch. Its spillway sill level is at 672ft. above O.D. and the storage it makes available is 1637 million cubic feet. For a distance of about a mile below the control weir the bed of the river has been deepened by about 4ft. Four miles downstream at Dunalastair there is an intake dam directing the waters into an aqueduct. This dam, which is illustrated in the Supplement, forms a reservoir with a surface area of about ⅛ square mile and a storage of 46·4 million cubic feet. Its spillway level is at 650ft. above O.D. and it is equipped with two sluice gates, 25ft. by 25ft., and four syphons for the discharge of flood waters. In order that fish may surmount it to the reaches of the river above there is a fish ladder of eighteen pools. The intake gates to the aqueduct are 14ft. wide by 12ft. high, and they are automatically controlled to maintain the static water level in the aqueduct at 646ft. above O.D. This aqueduct is lined with reinforced concrete and carries the water along the hillside for about 3 miles to the forebay structure above the Tummel power station. The forebay is built of reinforced concrete and has screens, stop log openings, and control gates. It admits the water to two steel pipes, 12ft. 6in. in diameter, which carry it down to the two horizontal Francis type 24,000 b.h.p. turbines built by Boving and Co., Ltd., in the power station. Electricity is generated at 11,000 volts, 50 cycles, three-phase, by B.T.H. alternators. The work was carried out by Balfour, Beatty and Co., Ltd., and Mr. W. T. Halcrow was advising engineer.

The Galloway Power Scheme.—The first stage works of the Galloway power scheme will begin to supply current to the grid in South-West Scotland early in the spring of the present year. The total catchment area to be brought under control when both first and second stage works have been completed is 396 square miles, principally in Kirkcudbrightshire. The watershed is drained by two rivers, the Dee and the Water of Ken, and the works now almost finished are concerned with the development of power from the Dee. The major work is the Clatteringshaws Dam, illustrated in the Supplement, which creates a reservoir with a surface area of 1000 acres with a top water level 585ft. above O.D. The drawdown available is 40ft. and the storage 7900 million gallons. From this reservoir the water passes through a tunnel 3½ miles in length and of horseshoe section, 11ft. 6in. greatest diameter, to a point on the hillside above the Glenlee powerstation. A pipe line varying in diameter between 9ft. 6in. and 8ft. 4in. takes the water down towards the power station, dividing near the bottom into two 6ft. diameter pipes, which each supply a 13,000-kW vertical Francis turbine. The net available head is about 365ft. and the water is released into the Water of Ken along a tail-race 900 yards in length. It flows unimpeded into Loch Ken, at the outlet from which there is situated the Glenlochar Barrage, the main regulator for the Tongland power station further downstream. Two thousand million gallons can be stored in Loch Ken between the levels 148ft. and 144ft. above O.D. At Tongland, across a gorge, the contours of which are somewhat complicated, a horizontal arch dam, 70ft. in height, has been built across the river and continued as a gravity structure as far as two free roller flood gates. The top water level in the reservoir so formed is at 120ft. above O.D. and a long fish ladder has been constructed so that salmon proceeding upstream may surmount the obstacle. A short tunnel in rock and a reinforced concrete pressure aqueduct, together 3800ft. in length, conduct the water to a surge tower. The aqueduct varies in diameter between 22ft. and 18ft. 6in., and beneath the surge tower divides into three. Thence three steel pipes encased in concrete carry the water down to the three 11,000-kW vertical Francis type turbines in the power station. Sir Alexander Gibb and Partners and Messrs. Merz and McLellan are the joint consulting engineers for this scheme, the work upon which has been carried out by a number of contractors.



THE LAGGAN DAM OF THE LOCHABER POWER SCHEME

India.

In India, as a general rule, considerations of water supply override possibilities for the generation of power. It is a country in which numerous water control works of minor or major importance have been built and continue to be built. The great Cauvery Mettur Dam, opened by Sir George Stanley, Governor

of Madras, on August 21st, is an exception to the general rule, in that eventually it will be equipped with a power-house and turbines to generate about 10,000 h.p., although its main purpose is to control floods and to create a reservoir for the storage of water for irrigation. The dam, which was fully described and illustrated in our issue of August 31st, has a length of nearly 1 mile and a greatest height from foundation level of 340ft. It is built largely of concrete, for the laying of which two great concreting towers, about 300ft. high, were made by Stothert and Pitt, Ltd., of Bath. Much local stone was used in the construction and Hadfields, Ltd., supplied a large crushing plant to deal with it. After the work of building had been begun a modification was made to the original plans and a masonry construction was substituted in some parts for the concrete. The reservoir created by this great work has an area of 59¼ square miles and stores 93,500 million cubic feet of water.

New Zealand.

Probably the biggest power plant ever tackled in New Zealand is now under construction on the Waitaki River. This river is subject to heavy floods and carries on these occasions a large burden of shingle. A dam one-third of a mile long is being built across the river to raise the water level by about 70ft. and to create a lake 5½ miles long by 1½ miles broad. To accommodate the large floods 1160ft. of the dam is built as a spillway, while the power-house building takes up another 325ft. Provision is being made for the installation of five turbines developing 100,000 h.p., but at present only two are being placed.

America.

Far the most interesting and important hydro-electric scheme in the United States is the Boulder Dam development, previously known as the Hoover Dam. It will be remembered that a great arch-shaped dam, 727ft. high, is now in course of construction across the Colorado River, about 25 miles south-east of the Las Vegas, Nevada. Its crest has a length of 1180ft. and it will create a reservoir 115 miles in length with a greatest depth of 580ft. The storage capacity amounts to 30,500,000 acre-feet. The power-house is situated immediately downstream of the dam and forms a U-shaped structure, the base of the U butting against the dam. Four intake towers, two on each side of the canyon, will admit the water to tunnels from which it is to be admitted to the turbines. The power plant is designed for the ultimate installation of fifteen 115,000 h.p. turbines and two 55,000 h.p. turbines. Initially, however, only four of the larger and one of the smaller turbines will be installed. Besides providing power, the development will control the flow of the river, preventing disastrous floods reaching the country below and regulating the flow for the irrigation of the Imperial Valley. In a series of articles we hope to publish shortly we shall continue our account of this great work from our issues of October 20th, 27th, and November 3rd, 1933.

The Physical Society's Exhibition.

No. I.

IN the trade section of the Physical Society's Exhibition, held at the Imperial College of Science from January 1st to 3rd, seventy-nine firms were exhibiting. Many examples of the latest developments in electrical and other instruments were, as usual, on view in addition to many fascinating pieces of apparatus in the research and experimental section. Among the latter were several developments of cathode ray tubes and electron cameras, including lens systems showing images of emitting surfaces on fluorescent screens. Among the wireless exhibits was a standard receiver for the measurement of radio interference, a map of England and Southern Scotland showing the electrical restivity of the earth, and an artificial mouth for testing telephones. Various devices for studying the behaviour of discharge tubes for illumination purposes were exhibited. Another fascinating illumination device was a gas burner for producing an intermittent flame of light.

The section devoted to the work of apprentices and learners in the employ of exhibiting firms consisted of examples of the work of those taking part in the annual competition in craftsmanship and draughtsmanship, which is organised by the Society in conjunction with the Exhibition. In accordance with the usual practice, three discourses were delivered on the three days the Exhibition remained open. The first was on "The Architecture of Molecules," by Dr. B. Wheeler Robinson; the second on "The Problem of Ether Drift," by Dr. C. V. Drysdale, and the third on "Giant Telescopes," by Dr. Spencer Jones.

Both the Salford instrument works and the research laboratories of the General Electric Company were

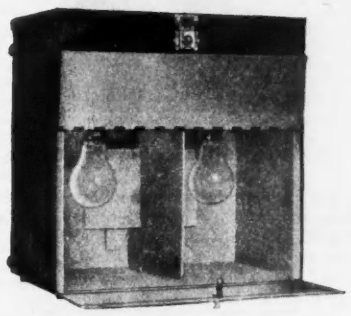


FIG. 1—COMPARATIVE PHOTOMETER

represented. Among the exhibits of the former was a comparative photometer (Fig. 1) for the quick and approximate comparison of similarly rated lamps by unskilled operators. As shown in the illustration, there are two compartments in which the lamps are placed. These compartments are approximately cubical, and a rectifier photo-electric cell receives reflected light from both. A selector switch first connects one lamp to the mains through an ammeter calibrated in watts, the photo-electric cell being connected to a micro-ammeter calibrated in percentage lumens. A shutter is operated so as to adjust the reading to 100 per cent. lumens when the switch is operated to connect the second lamp, without altering the shutter. The percentage lumens of the second lamp are then read directly and the watts input may also be compared. For a visual comparison both lamps may be switched on and the front opened. The improved light output of a coiled-coil lamp can be shown, and also the increased lumen output from a lamp of standard make over an inferior lamp.

Valve voltmeters—Fig. 2—covering various ranges for various purposes and for A.C. mains or battery operation, were shown, some being of the rectifier type and others of the anode bend type, depending on the range and purpose for which the instrument is required. Multi-range instruments up to five ranges are supplied, all suitable for measurements at power and radio frequencies.

In the research and experimental section of the Exhibition the research laboratories of the General Electric Company, Ltd., were showing examples of recent developments in many different directions.

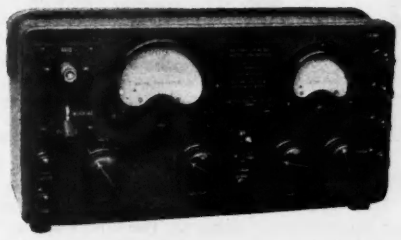


FIG. 2—VALVE VOLTMETER

Among other things there were a tensile testing machine for testing wire, photo cells for use with ultra-violet radiation, a high-speed relay for use with a photo-cell unit, an E.H.T. gas-filled rectifying valve, and a portable brightness meter.

The testing machine (Fig. 3) has been developed particularly for making tensile tests on fine wires used in electric lamp and valve manufacture under conditions which can be repeated easily. A feature of the machine is straining at a constant rate which, for special reasons, is preferable to the more usual method of applying stress at a constant rate. The normal speed of straining is 4 mm. per minute, but it can be increased to 14 mm. per minute by the use of change wheels. A quick return at 50 mm. per minute is provided, and the straining screw stops automatically at each end of its traverse. The straining screw has a pitch of 2 mm., and is driven by a 20 to 1 ratio worm gear, which is also used to measure the strain, one revolution of the worm wheel corresponding to $^1/_{10}$ mm. of strain. Readings of strain are given by a revolution counter connected to the worm shaft and mounted on the table of the machine, where it can be viewed by the observer when desired. The load on the wire is measured by means of a simple cantilever spring to the end of which an engraved glass scale is attached. The scale is optically projected on to a screen in front of the observer, who notes the load reading at intervals of time corresponding to ½ mm. increments of strain, these intervals being indicated by flashes of light from a small lamp connected in circuit with a contact operated by the straining screw. The observer can stop the machine instantaneously by means of a clutch operated by a pedal. Three cantilever load springs are provided with ranges of load 0 to 150 grammes, 0 kilos. to 1·5 kilos., and 0 kilos. to 15 kilos. Owing to deflection of the cantilever it is necessary to apply a small correction to the strain reading given by the revolution counter when interpreting results of tests, although in many instances comparative tests of value may be obtained without making this correction.

The reverberation meter shown in Fig. 4 was exhibited by the Western Electric Company, Ltd. It can be used for determining the reverberation period of auditoriums, sound studios, &c., and for assessing the coefficients of absorption of materials. A heterodyne oscillator produces a warble tone in a loud speaker in the auditorium in which the reverberation period is being measured, the tone in the auditorium being interrupted by a cam-operated contact carried by a timing drum revolving at constant speed. The position of the drum at which the interruption takes place represents zero time, and the sound in the auditorium decays at a rate governed by its dimensions and absorption coefficients. The decaying sound is picked up by a microphone and its output is passed

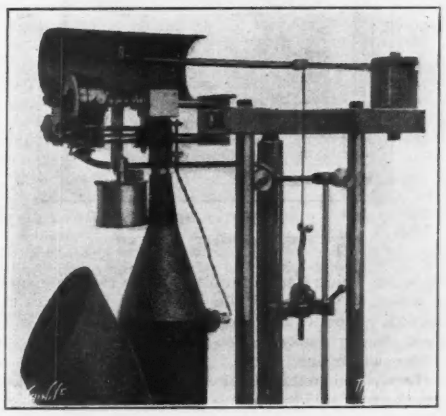


FIG. 3—WIRE TESTING MACHINE

on to an amplifier followed by an adjustable attenuator, rectifier and polarised relay. With the sound in the auditorium maintained at a constant level, the attenuator is adjusted so that the relay just operates and the effective gain of the amplifier is then increased by a known amount by changing the setting of the attenuator. When the sound level at the microphone face has been decayed through a range equal to the increase in gain of the amplifier, the relay closes the circuit of an induction coil which causes a spark to mark sensitised paper on the timing drum, and the distance on the drum between the position representing zero time and the spark mark is a measure of the time decay of the sound through a change of level equal to the increase of gain of the amplifier. The cam of the timing drum then resets the circuit, and the sequence of operations is continuously repeated. By changing the setting of the attenuator by a known amount and by varying the frequency, a family of decay curves is plotted and from the data obtained

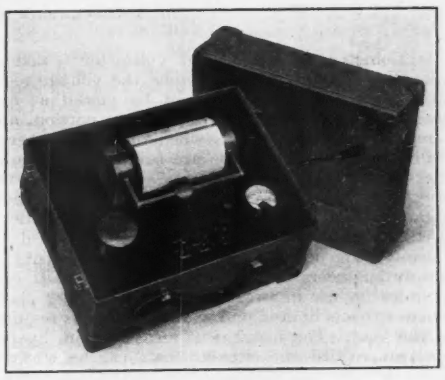


FIG. 4—REVERBERATION METER

the reverberation time-frequency curve of the auditorium is deduced.

Among the exhibits of Ferranti, Ltd., was the light testing instrument shown in Fig. 5, consisting of a sensitive cell of the photo-voltaic type, combined with a 2½in. moving coil instrument calibrated to read directly in foot-candles at the cell surface. Both the cell and instrument are mounted in a moulded black case and no accessories are necessary. By means of a small switch, two ranges, of 25 and 250 foot-candles, are made available. Other Ferranti exhibits consisted of electro-static voltmeters, a maximum demand ammeter, self-starting synchronous motors, an electric stop clock, and automatic synchronising equipments. In the latter apparatus the principle

of the thyratron is used for the automatic synchronising of alternators. A relay controlling the necessary switchgear operates by the discharging of the tube, which is only permissible when the grid voltage has reached a sufficiently small negative value, corresponding to a particular anode voltage. The voltage applied to the grid is obtained from a phase opposition connection of the machine and bus-bar voltages,

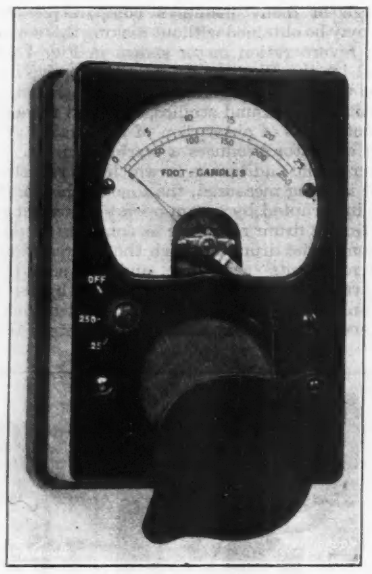


FIG. 5—LIGHT TESTER

the value being a minimum when the two are exactly in phase, thus allowing the valve to discharge at that instant. Operation is prevented if the slip is too great, and provision is also made for lag in the closing of the switchgear.

One of the exhibits of Everett Edgcumbe, Ltd., was the portable insulating oil tester, shown in Fig. 6, consisting of a 40-kV transformer, test cell regulating

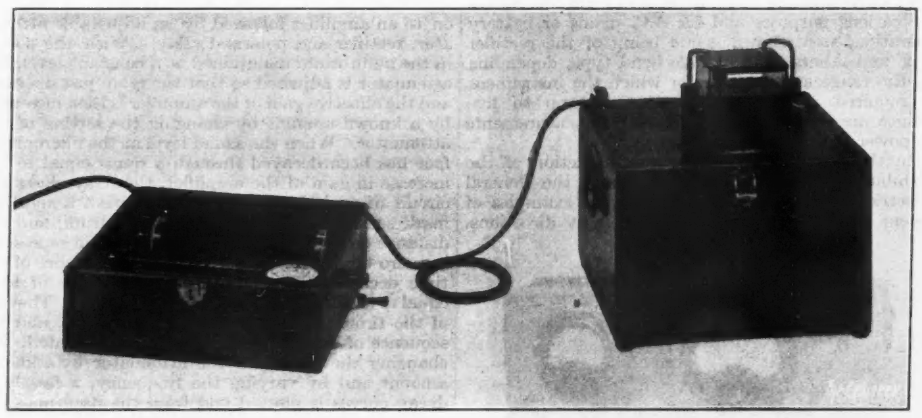


FIG. 6—INSULATING OIL TESTING EQUIPMENT

potentiometer resistance, and voltmeter scaled in kilovolts. The portion containing the voltage regulating and measuring gear can be placed at any desired distance from the high-voltage portion, and a red warning lamp shows when the transformer is "alive." Exhaustive tests are said to have shown that in spite of the small size and weight of the apparatus, the measurements agree closely with those obtained with large testing sets. The "Cadet" portable grapher—Fig. 7—has been developed by Everett Edgcumbe to meet the requirements of supply engineers and others who are in need of a recorder for use in street pillars and in other places where space is limited and where a record is required of the load. The instrument measures 9in. by 6in. by 4½in., whilst the circular chart has an effective width of 2½in. and can be arranged to rotate once a day or once a week, as desired. As it is driven by a Synclock clock, no winding is required and the time-keeping is always accurate. Normally the pointer swings clear of the chart and is depressed on to it at intervals of six seconds. Under the chart, and at right angles to the index pointer, is a raised knife edge, and when the pointer is depressed the chart is gripped between the pointer and knife edge, thus leaving a dot on the paper corresponding with the position of the pointer at the moment.

Evershed and Vignoles, Ltd., were showing, among other things, an equipment specially designed for water level indication with a circular indicator—Fig. 8—having a scale 36in. long. There are no electrical contacts on the transmitter or other parts of the circuit, the variation in the current which provides the indication being obtained by varying the inductance of the circuit. The system is therefore specially

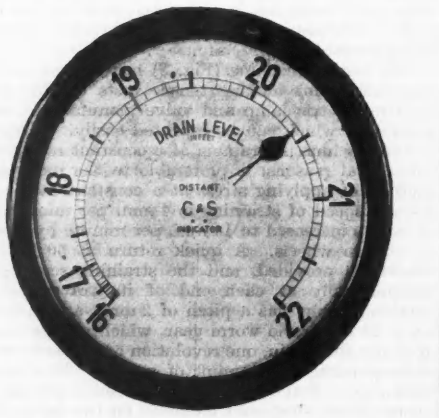


FIG. 8—WATER LEVEL INDICATOR

suitable for use where the conditions are severe, as, for example, on sewage disposal schemes. The apparatus is operated from a single-phase circuit and the accuracy of the reading is said to be independent of frequency and voltage variations.

A specially sensitive recording instrument with a

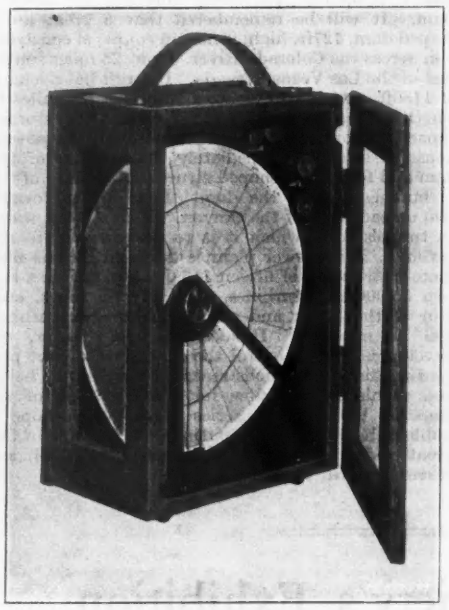


FIG. 7—PORTABLE GRAPHER

resistance of 1500 ohms per volt, for use as a voltmeter or an ammeter, was shown. The instrument has been designed for use in connection with electrolysis investigations on tramway systems and consists of a recorder in which the marking of the chart is made through a typewriter ribbon by periodical tapping of the needle on the paper, the rate of tapping being four dots per minute. The speed of the continuous roll chart, which is 3½in. wide, is 1in. per hour, but can be altered to suit requirements by changing one pair of wheels. The instrument is mounted in a cast aluminium case for portable use, but it is also fitted with brackets so that it can be mounted on a wall, if desired. The instrument has a centre zero and is fitted with a number of terminals for different ranges from 10–0–10 millivolts to 300–0–300 volts. By using the millivolt range with external shunts the instrument can be used as an ammeter.

Another Evershed and Vignoles exhibit was an equipment for the transmission to a distance of an indication record and integration of a flow. The originating movement is provided by a ring gauge made by George Kent, Ltd., the current transmitted being varied in proportion to the originating quantity, so that the indication and integration of this current is equivalent to integrating the flow that is being transmitted. One panel is equipped with the originating movement, a control ammeter, Evershed-

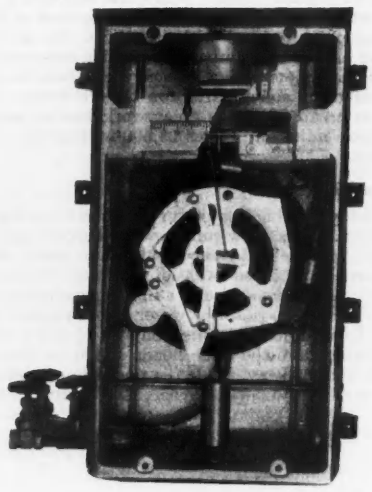


FIG. 9—TRANSMITTER

Midworth transmitter—Fig. 9—and a rectifier equipment to enable the apparatus to take current from an A.C. supply. The receiving panel—Fig. 10—is fitted with an Evershed recording instrument with a 6in. continuous roll chart, an indicating instrument in the form of a 12½in. sector type ammeter scaled in terms of flow to correspond with the originating movement and a milliampère hour meter by means of which integration is obtained of the originating

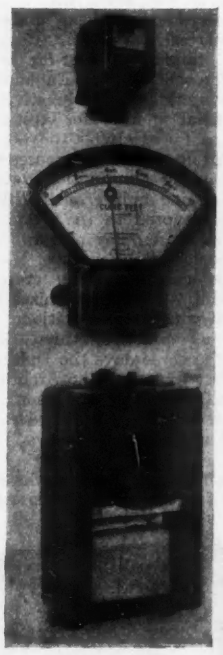


FIG. 10—RECEIVING PANEL

quantity. Other exhibits, consisting of the "Meg" insulation tester, the "Meg" earth tester, and the Knowles-Shotter automatically protected leakage ammeter are too well known to call for description.

(To be continued.)

THERE has recently been installed at the U.S. Bureau of Standards an improved type of apparatus for the study of the ageing of rubber. The equipment is designed to maintain rubber test samples at a temperature of 160 deg. Fah. in circulating fresh air for considerable periods of time. Formerly large ovens were used for the purpose, but they had the disadvantage that samples sometimes became contaminated by volatile products from adjacent samples of different composition, so the present apparatus was built with a number of small ovens, one for each sample. To facilitate temperature control these ovens are mounted in thermostatically-controlled water baths. Circulation of fresh air is secured by providing each with a small inlet and a chimney. The insulation and distribution of heating elements are such that it is possible to obtain sufficiently uniform temperatures without stirring either the water bath or the air in the ovens.

Rail and Road.

WE regret that owing to a typographical error, the name Parkinson was printed for Tomlinson in a paragraph in this column last week referring to the Tay Bridge disaster.

THE driver concerned in the French railway disaster at Lagny of December 23rd, 1933, recently underwent his trial on a charge of homicide by imprudence. Judgment was deferred.

WHILST the discussions between representatives of the railway companies and of the railway trades unions, as to a new conciliation scheme to replace that which came to an end in March last, still continue, there is no indication at present of any agreement on the subject.

THE Sevenoaks extension of the electrification of the Southern Railway will be opened on Sunday next, January 6th. Electric trains will run over both routes to Sevenoaks —the direct route *vid* Orpington and that through Swanley Junction. The extension to Eastbourne and Hastings is expected to be opened next summer.

DURING the past year no fewer than 136 installations of street traffic signals have been brought into use in the London traffic area, involving the erection of 737 standards. These figures bring the total number of street traffic installations in the London traffic area up to 374, of which 246 are in the Metropolitan boroughs.

FROM a statement made in the House of Commons on December 17th, it would appear that the scheme for electrifying the lines radiating from Liverpool-street is still under the consideration of the joint standing committee of representatives of the four grouped companies and of the London Passenger Transport Board.

ACCORDING to the latest official statistics prepared by the Ministry of Transport from information supplied by the railways, the trains of all standard gauge railways covered a total of 48,383,795 miles during the four weeks ended September 8th, 1934, an increase of 1,818,317 miles, as compared with the corresponding period of last year.

THE suggestion, made in a question to the Minister of Transport on December 12th, that workmen's fares should be reduced correspondingly with the decrease in ordinary fares, was met by the answer that that was a matter for the Railway Rates Tribunal. The rates at present in force came into operation on January 1st, 1928, and have since been reviewed annually by the Tribunal.

IN a letter to *The Times* of December 24th, Mr. C. Peter Sandberg mentioned that steel sleepers have been undergoing tests on British railways since 1921, and that the difficulties anticipated in using them have been overcome and the fears as to noisy and hard riding have proved to be groundless. The letter concluded by remarking that "the price of steel sleepers is now comparable with that of wooden sleepers, and with the satisfactory experience which the railways have now acquired with several types, they may be warranted in extending their use, both to their own advantage and for the benefit of the steel industry of the country, and the question is therefore one of national importance."

AN opportunity was given Mr. Hore-Belisha, before Parliament adjourned, to defend himself against charges made as to making decisions regarding pedestrian crossings without due consideration. The Minister of Transport, in reply, said that no local authority had asked him to illuminate the beacons. At this moment another survey was proceeding over the whole of the administrative area of London to review the position in which the beacons were placed, so that mistakes could be rectified. He was only making an experiment. He was not a dictator. Everything would be done which experience showed was of public advantage. The figures of the casualties showed that the experiment was promising well, and if anybody could show him a better method than the one he was pursuing he would be glad to know it.

THE railway accident statistics for the past year have, as regards the number of passengers killed in train accidents, been the worst since 27 passengers were killed in 1927 and 48 in 1928. The total of such fatalities for last year was 16. Six passengers lost their lives in the Port Eglinton collision of September 6th, and ten in that at Winwick Junction on September 28th. There were thus only two fatal train accidents last year, which equalled the yearly average for the years 1929–1933 inclusive, and compared with the three fatal accidents in 1926, four in 1927, and six in 1928. It is gratifying to report that the number of trainmen killed in railway accidents during 1934 was less than in 1933. During 1933, eleven men were killed in six accidents; last year seven were killed in four. Of the seven, three were the enginemen who lost their lives in the Port Eglinton collision, and two were the enginemen killed in the level crossing collision of November 27th at Wormley.

A VERY interesting case, which is, however, likely to be appealed against, was decided at the Bow-street Police Court on Friday, December 29th. A passenger who had alighted from a tramcar without paying her fare was summoned for an offence against a by-law made in 1920 which provided that "each passenger shall, immediately upon demand, or, in case no demand shall have been made, before leaving the carriage, pay to the conductor the fare legally demandable for his journey and accept a ticket therefor." The passenger's answer was that she was not given an opportunity to pay the fare. By-laws were sanctioned by the Tramways Act, 1890, subject to the approval of the Board of Trade, but there was a proviso that they were not to be repugnant to the laws of England. The case was dismissed by Sir Rollo Graham-Campbell because the words relied upon in the by-law under consideration were repugnant to the laws of England; in the same way, the by-law appeared to be bad as being unreasonable. The present judgment is of added interest because of the reference to the case in 1894 of Huffman *v.* North Staffordshire Railway Company, in which it was shown that a by-law, as to a passenger using a ticket on a day when such ticket was not available, being subject to a penalty not exceeding 40s., was, under the Regulation of Railways Act, 1889, invalid unless it was intended to avoid payment.

Miscellanea.

IT is with great heartiness that we offer our sincere congratulations to *The Times* on its one hundred and fiftieth birthday. Perhaps we can pay our great contemporary no higher compliment than say that we were reminded with a shock that it is no more than a century and a half of age. It had seemed to us that it was as old, at least, as the British constitution itself, and that its origin was lost in the past; we could not think of a period when *The Times* had not begun to steady a sometimes feverish world by its sobriety and moderation.

A HYDRO-ELECTRIC project to supply power to Jalalabad is reported to have been undertaken by the Afghan Government.

TO further the British motor industries' interests in India, Burma, and Ceylon, the Society of Motor Manufacturers and Traders has decided to establish an office in India.

IN the more distant districts around Stockholm there is now available a service of compressed gas for illuminating and cooking purposes, the gas being supplied in "bottles" containing the equivalent of 6000 litres of gas.

WORK has been started on the construction of the new coal distillation plant of Coal and Allied Industries, Ltd., at Seaham Harbour. The works, it is said, will cost £250,000, and will handle 500 tons of coal a day.

WHAT is claimed to be the largest Titan crane in the United Kingdom has been erected at Billingham by Sir William Arrol and Co. It is designed to handle a working load of 170 tons and was satisfactorily tested with a load of 212 tons.

EXPERIMENTS in radio telephony between Great Britain and Northern Ireland have proved successful, and the new service enabled the authorities to cope with the increasing demand for ordinary trunk telephone calls between the two countries during Christmas.

IN an editorial article of December 8th, *Indian Engineering* deplores the lack of facilities, in that country, for the testing of the strength of materials, and urges that either the Alipore Test House should be enlarged and thrown open to engineers in general, or that some other testing authority should be established on the lines of the Building Research Station in England.

ADDRESSING the Incorporated Sales Managers' Association, Mr. D. Havinden, of the Coal Utilisation Council, said that "the coal resources in Britain are such that we have no need to bother about them at all. We have enough known coal reserves in this country to last for 550 years if we mine 250,000,000 tons a year. Our present output is between 200 millions and 250 million tons a year."

DEALING with open-hearth slag tests in *Stahl und Eisen*, Mr. R. Back discusses the characteristic appearance of slag buttons taken at various stages of the open-hearth refining process and correlates the appearance with their composition. In acid and slightly basic slags the surface appearance and nature of the fracture provide, he says, a useful guide to the manganese, iron and silica contents.

THE Minister of Transport was asked recently in the House of Commons what was the total consumption of coal for the years 1913 and 1933 in the gas and electrical industries, respectively. He replied that the coal consumption at the electricity generating stations of authorised undertakers and railway and tramway authorities was 10·33 million tons in 1933 and 4·9 million tons in 1913. The amount of coal carbonised at gasworks was 17·36 million tons in 1933 and 17·37 million tons in 1913.

THE latest information concerning the German coal hydrogenation experimental plant of the I. G. Farbenindustrie, at Oppau, shows that in the three months the plant has been in operation 1500 tons of coal from the Ruhr have been treated; in November the average daily consumption was 20 tons. Up to 96 per cent. of the coal substance was converted into hydrogenation products, and 13 to 14 tons of oil were produced each day. About 14 per cent. of the coal substance was converted into gaseous products.

THE effect of maximum heating temperature on the running quality of liquid metal for two grades of aluminium and an aluminium–8 per cent. copper alloy has been studied by the American National Bureau of Standards, and the experiment is reported in a recent research paper. The running quality was measured in terms of the length of a spiral casting obtained by pouring the metal under carefully controlled conditions. The effect of various treatments of the metal was also investigated. It was found that the relation between length of the spiral and the pouring temperature is linear. Pure aluminium (99·8 per cent.) was found to have markedly higher running qualities than the commercial (99·2 per cent.) aluminium. The running quality of the aluminium–8 per cent. copper alloy was not greatly different from that of commercial aluminium.

A PROCESS for the manufacture of cellulose pulp, in which hemlock and spruce has been used as the raw material in plastics production by L. Lowen and H. K. Benson, of the University of Washington, was described in an abstract in the *Chemical Trade Journal*. The sheets or "laps" were disintegrated in a small laboratory pulp beater and the resultant pulp was centrifugalised, fluffed, and dried. It was stored in the air to an equilibrium moisture content. Either phenol or cresol was added in approximately equal weight, and hydrochloric acid in all cases constituted the condensing agent. After thoroughly mixing these materials the mixture was heated for six hours at 70 deg. Cent. and air dried for five or six days. It was then ground in a ball mill for half-an-hour. The ground powder was heated at about 80 deg. Cent. until plasticity developed, and it was placed in moulds and subjected to a pressure of 5 tons per square inch for five minutes. The moulded plastic was then baked at a gradually increasing temperature up to 150 deg. Cent. until it became hard. The addition of glycerol in all cases yielded a more plastic product prior to moulding, and seemed to increase the strength and homogeneity of the pressed and baked product.

Air and Water.

A CONFERENCE of German harbour masters is to take place in Hamburg to discuss the possibility of eliminating undue competition between the various German ports.

REPRESENTATIONS have been made by the Bo'ness Town Council for a grant to assist a scheme whereby some 2050 acres of foreshore between Bo'ness and Grangemouth may be reclaimed.

THE Greek High Naval Council has decided to have two new destroyers built, each having a tonnage of 1375 and a speed of over 35 knots. Both of these boats are to be built in this country.

ALL speed records for land aeroplanes have been broken by Monsieur R. Delmotte, who recently attained a speed of 505·848 kiloms., or 314·3 miles per hour, in a test flight over a distance of 3 miles.

DURING 1934 67 vessels, aggregating 268,121 tons, were built on the Clyde and 10 vessels, aggregating 87,613 tons, at Belfast, while the North-East Coast output for the year reached 48 vessels of 87,211 tons.

A MARCONI-ADCOCK wireless direction-finding equipment is to be installed at the Mersa Matruh aerodrome, near Alexandra. The aerodrome is used by the Imperial Airways machines on the African and Indian routes.

IT is announced that from the end of January the French Transatlantic liners are to call at Southampton instead of Plymouth on their way to New York. On the eastward journey they will continue to call at Plymouth.

ACCORDING to *Flight*, new air lines between Archangel and Onega, between Archangel Ust-Tsilma and Naryanmar, and between Archangel and Skytvikar are to be put into operation. The largest northern air line of the Soviet Civil Air Fleet, from Irkutsk to Yakutsk (1680 miles) will be reopened.

THE U.S.S.R. airship "V 6" has been completed and put into service between Moscow and Sverdlovsk. It is of the all-metal semi-rigid type, with a length of 105 m., a volume of 20,000 cubic metres, a carrying capacity of 8½ tons, and is fitted with three engines. A wireless transmitter with a radius of 1500 kiloms. is carried.

THE new aerodrome at Majerhat in Alipore, Calcutta, has been completed, and a suitable site has been selected for the buildings, construction of which will be begun shortly. At present planes embark and disembark passengers, mails, and freight at Majerhat, flying across to Dum-Dum for hangar accommodation and servicing purposes.

THE air park at Hanworth is to be developed as a modern air port, with extra accommodation for aircraft and fresh provision for service. A new hangar is to be built with a floor space of 12,000 square feet, and extra equipment to be installed will include lighting for night flying. Arrangements will be made so that the aerodrome may be fully illuminated within five minutes of an aeroplane being reported overhead.

THE King's racing yacht "Britannia" is being brought up to date for the 1935 racing season. The principal alteration will be the substitution of two head sails for her present three. One of the new sails will be a double-clewed jib, which will have the same area as the jib and jib topsail which it will replace. The copper sheathing is also to be removed, and she will, henceforth, have a painted surface instead of a copper surface. A new boom is also being fitted, designed to give the mainsail a better flow.

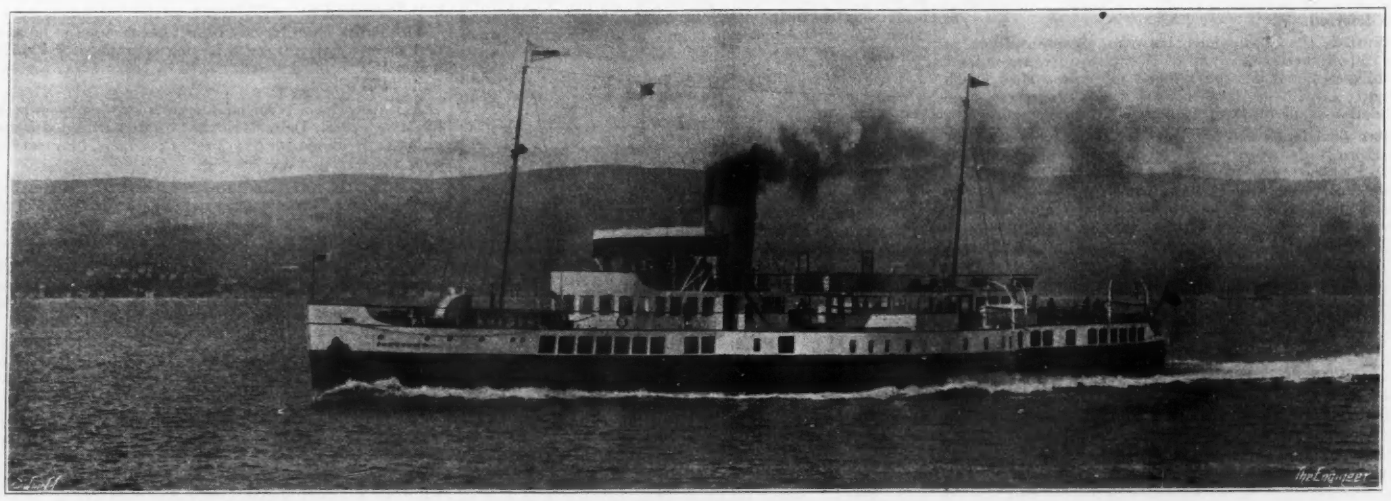
A RECENT issue of *The Times* described a new system of metal aeroplane construction which was demonstrated at the works of the Martin-Baker Aircraft Company. In place of welded joints a new type of nut and bolt fastening is used throughout the structure, and the stringers of the fuselage are strips of stainless steel of U-section, sprung by hand into fixed clips. These and other features of the design make it possible rapidly to dismantle any part of the structure for repairs or maintenance. The system should lend itself to economical mass production.

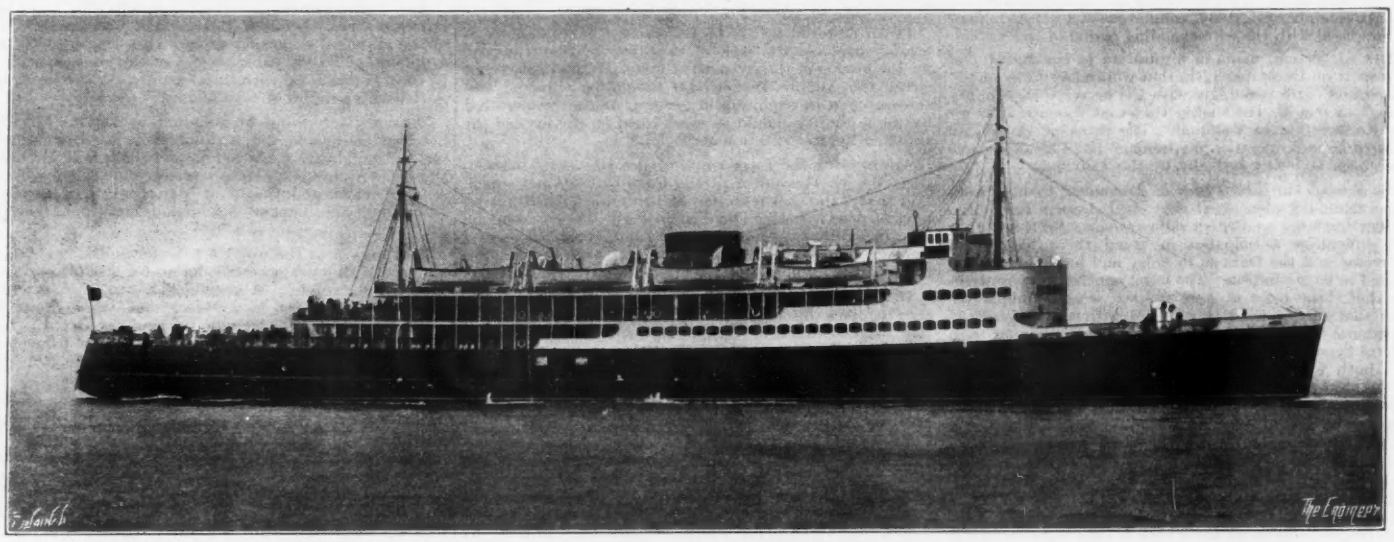
DURING 1934 the Royal National Lifeboat Institution reports that the number of launches was 340 and that 354 lives and 54 boats and vessels were saved. Five new motor lifeboats have gone to the coast during the year—to the Lizard and Coverack (Cornwall), Flamborough (Yorkshire), Cromer (Norfolk), and Maryport (Cumberland). There are now 124 motor lifeboats and 49 pulling and sailing lifeboats, making a fleet of 173 lifeboats round the coasts of Great Britain and Ireland. The Institution has experimented with a heavy oil engine for lifeboat work, and is continuing these experiments. It has decided to add to its fleet a new type of motor lifeboat, much lighter than any at present on the coast. The lightest of the existing boats is 35ft. 6in. long, weighs 6¾ tons, and is driven by a 35 h.p. engine. The new type will be 32ft. long. It will weigh only 3½ tons, and will have two 10 h.p. engines.

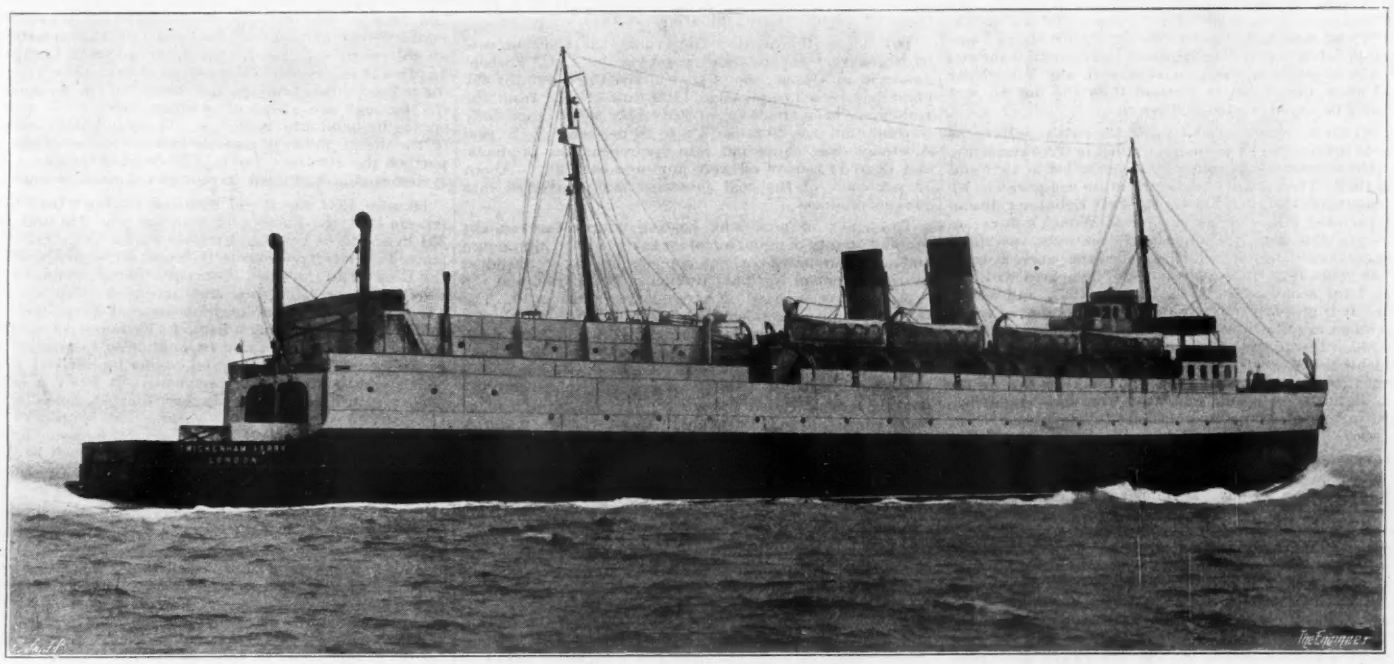
THE German firm of Maybach Motorenbau recently celebrated its twenty-fifth anniversary at Friedrichshafen in the large hall of the Zeppelin Casino. More than 1500 attended the celebrations, including the late Count Zeppelin's daughter, Countess von Brandenstein-Zeppelin, who is said to have persuaded her father to carry out his airship ideas more than thirty-five years ago. Dr. Karl Maybach, who with the late Count Zeppelin was responsible for the founding of the firm, gave an interesting survey of the pioneer work done by his father, Wilhelm Maybach, together with Gottlieb Daimler, and recalled his first six-cylinder airship engine, incorporating a fireproof carburetter. Failure occurred owing to vibrations caused by a wrong type of coupling. After the coupling had been modified, the engine became a great success with the same type of crank shaft. It is extraordinary that twenty years later, a similar failure occurred over the South of France, when an unsuitable type of coupling had been used in an airship. After fitting a new flexible coupling, the same engines remained in continuous service, and have just recently completed their millionth kilometre. Dr. Maybach started his firm, in collaboration with Count Zeppelin, when he was hardly twenty-five years old.

SOME STEAM AND MOTOR SHIPS OF 1934

(*For description see page 6.*)

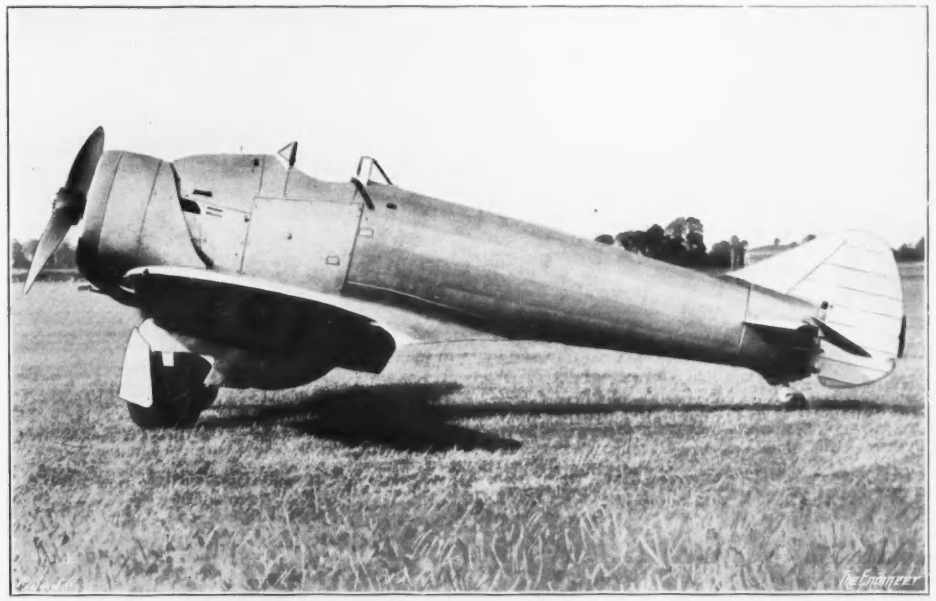






ABOVE:—CLYDE PASSENGER STEAMER "CALEDONIA"
CENTRE:—CROSS-CHANNEL MOTOR SHIP "PRINCE BAUDOUIN"
BELOW:—TWIN-SCREW S.S. "TWICKENHAM FERRY"

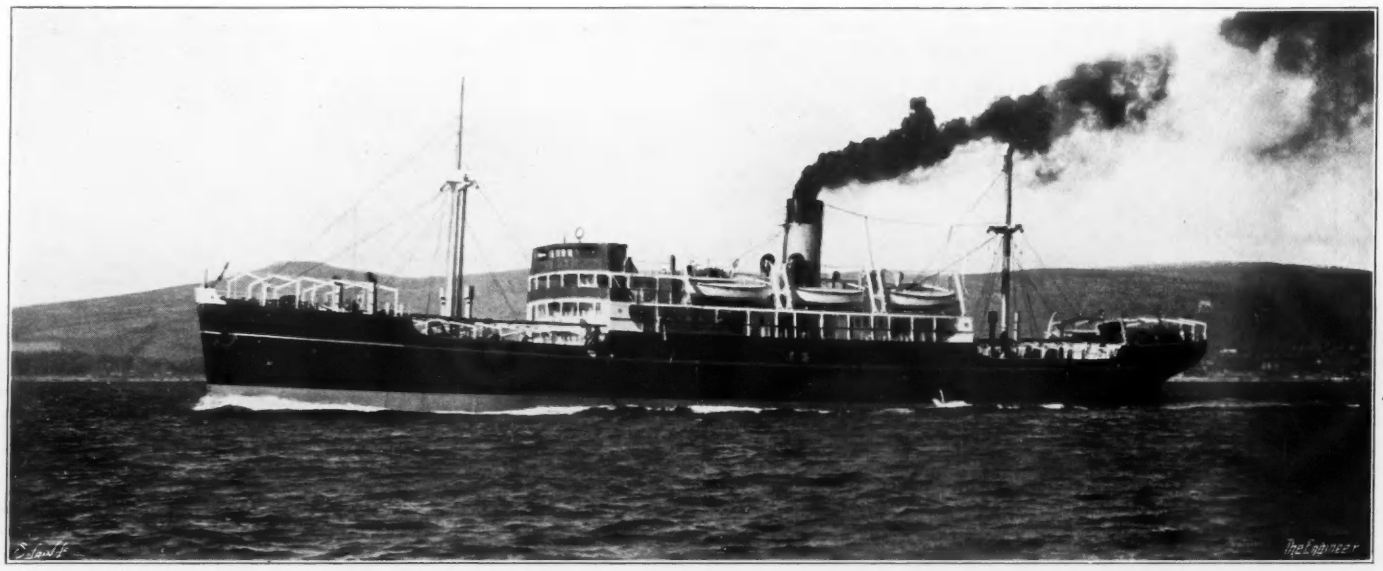
FOUR BRITISH MILITARY AIRCRAFT OF 1934

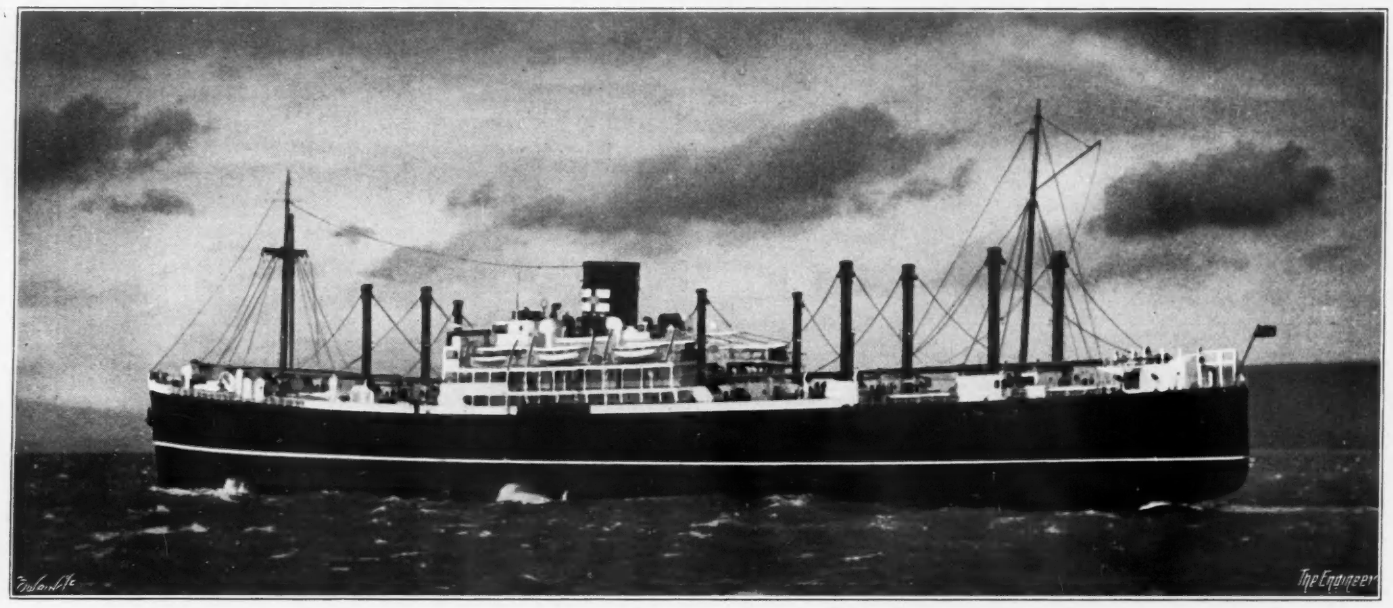


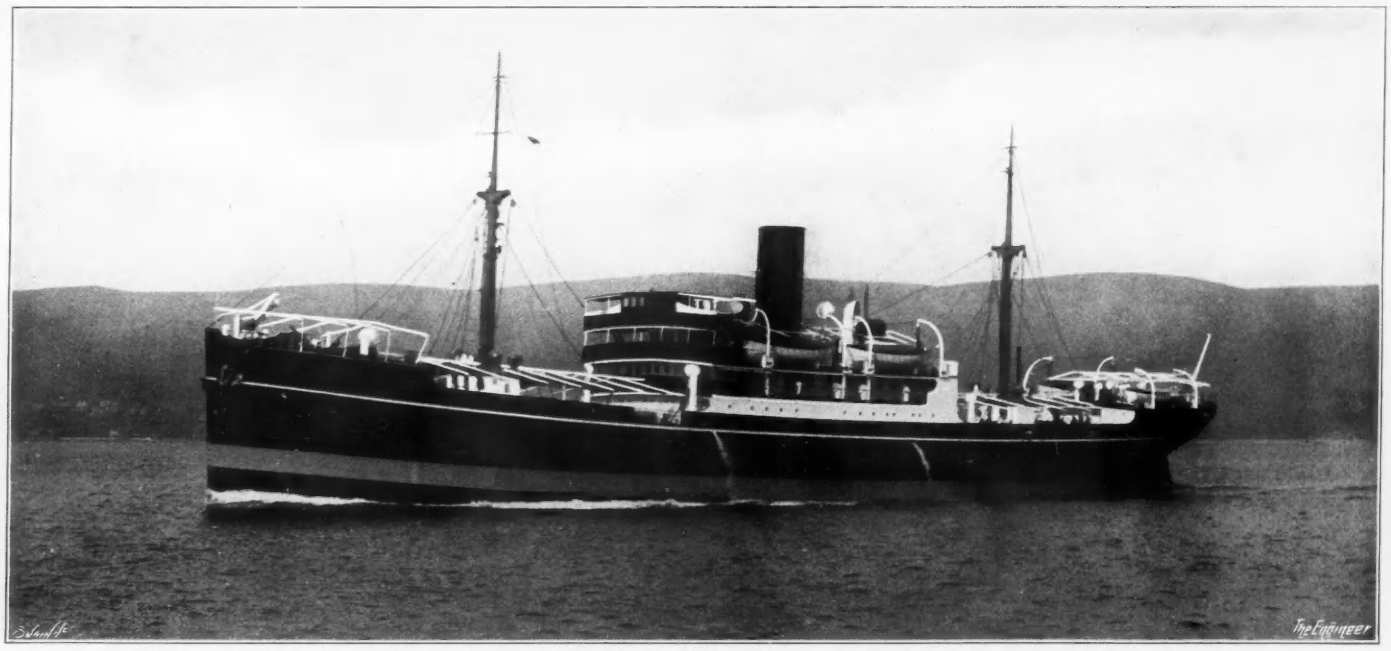
ABOVE:—BRISTOL "TYPE 133" SINGLE-SEATER FIGHTER AND INTERCEPTOR
BELOW:—HAWKER FOUR-GUN FIGHTER

ABOVE:—VICKERS "VINCENT" GENERAL PURPOSE MACHINE
BELOW:—WESTLAND "F 7/30" SINGLE-SEATER FIGHTER

STEAM AND MOTOR SHIPS OF 1934

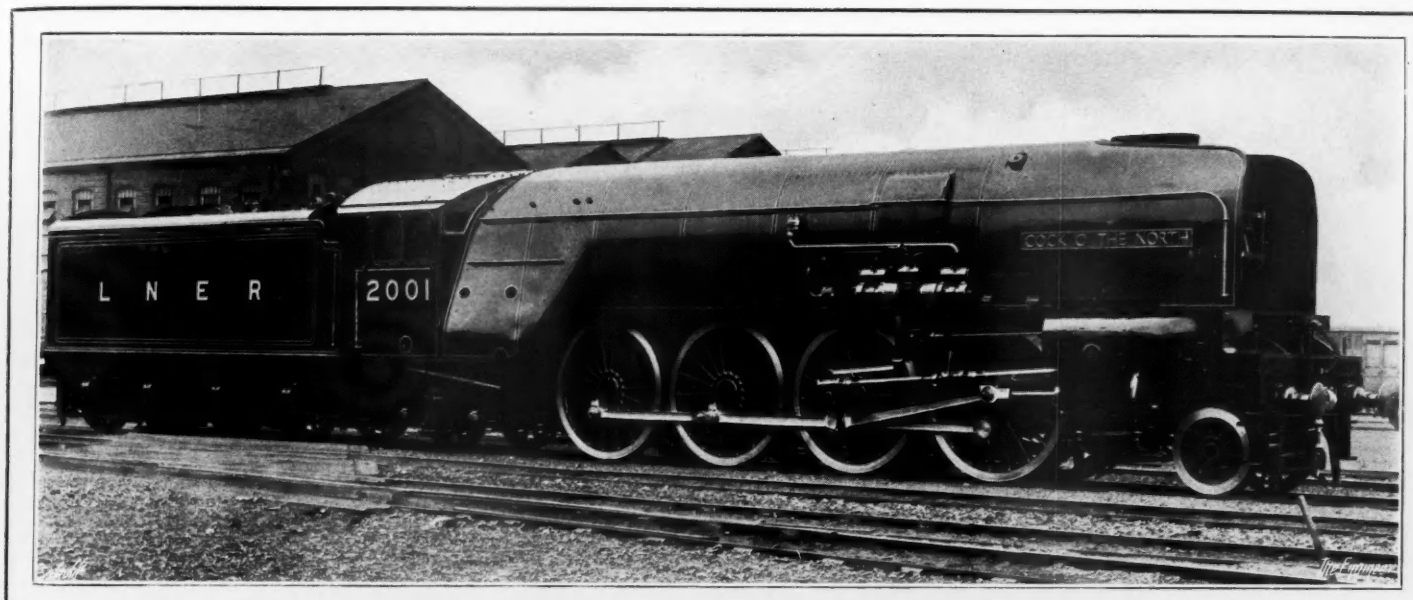


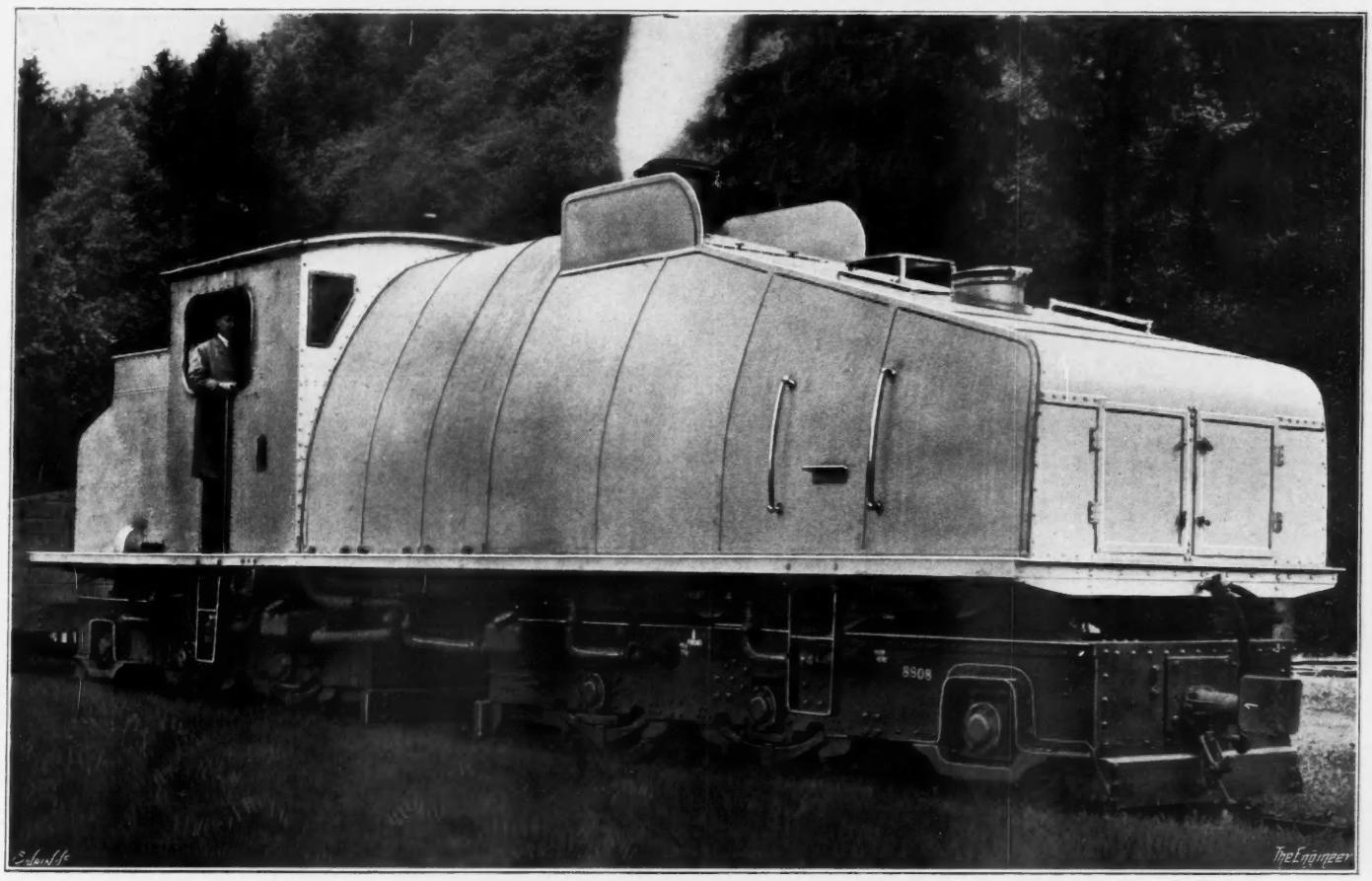


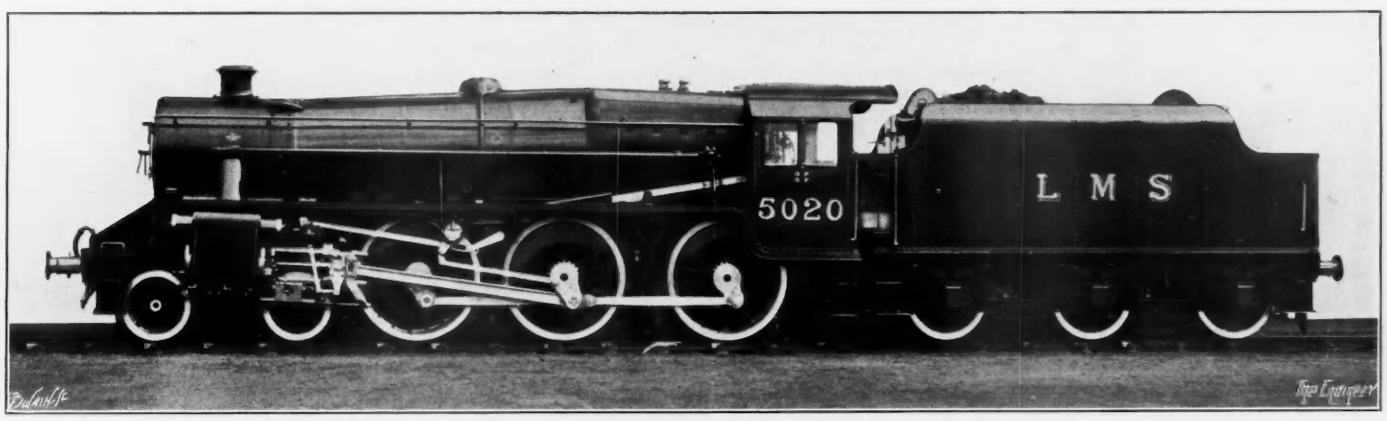


Above:—S.S. "Hai Chen"—China Merchants Steam Navigation Company
Centre:—M.S. "Dorset"—Federal Steam Navigation Company, Ltd.
Below:—M.S. "Yunnan"—China Navigation Company, Ltd.

SOME LOCOMOTIVES OF 1934





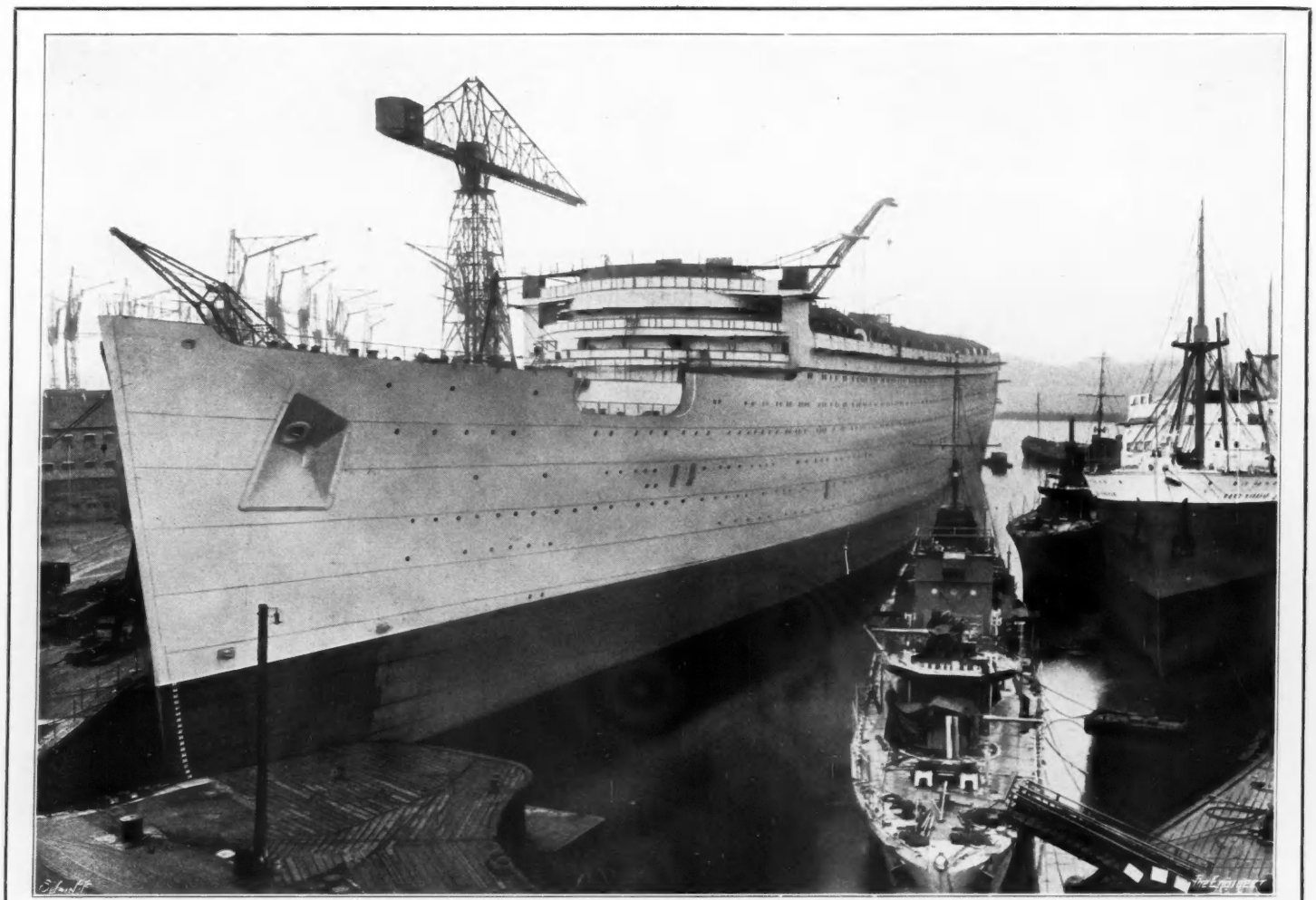


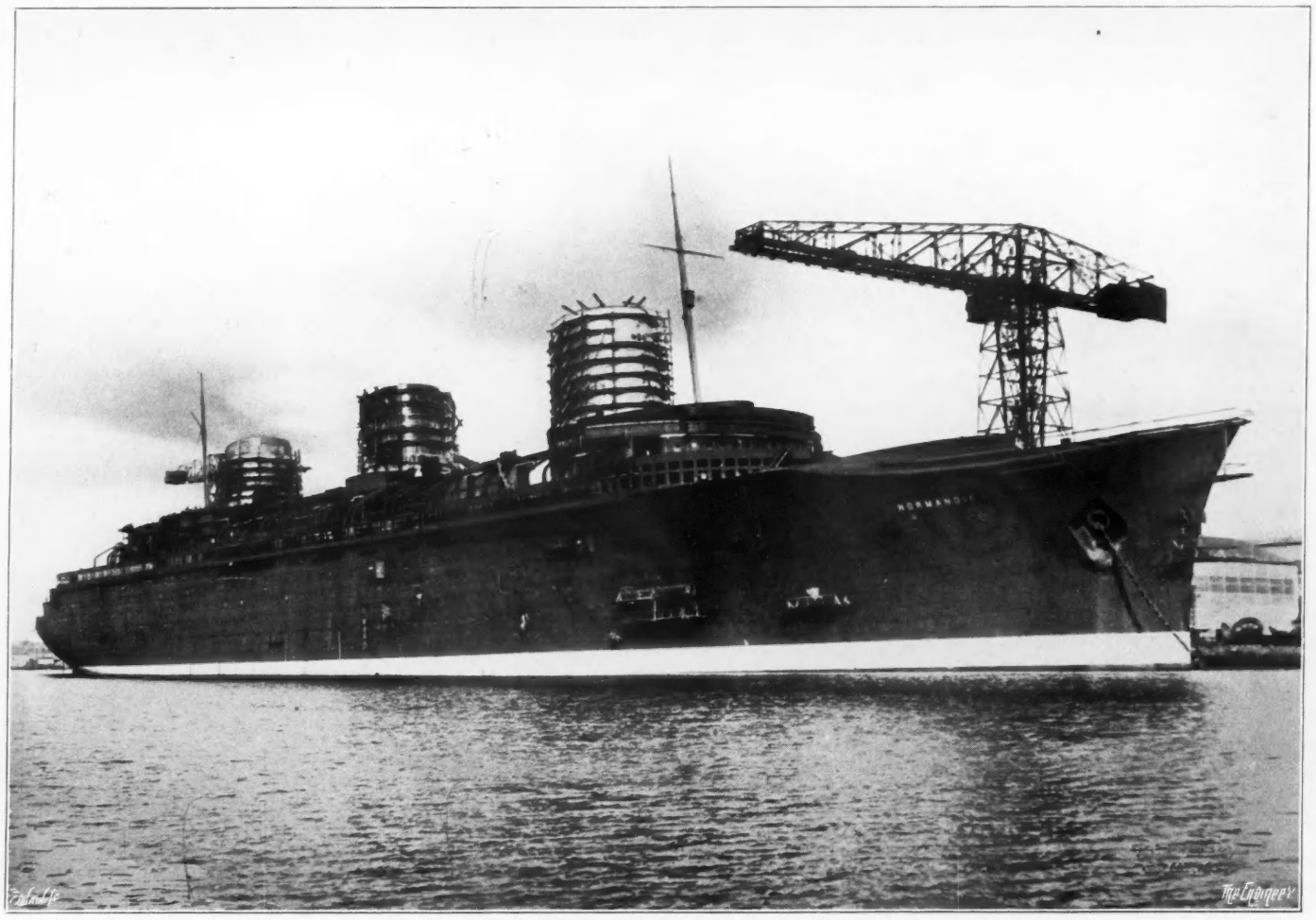
Above:—L.N.E.R. Express Passenger Engine

Centre:—Six-Engined Metre Gauge Locomotive for Colombia

Below:—L.M.S. Mixed Traffic Locomotive

THE WORLD'S TWO LARGEST LINERS OF 1934





ABOVE:—THE CUNARD-WHITE STAR 73,000-TON LINER "QUEEN MARY"
BELOW:—THE FRENCH LINE 79,000-TON LINER "NORMANDIE"

TWO LIFT BRIDGES OF 1934

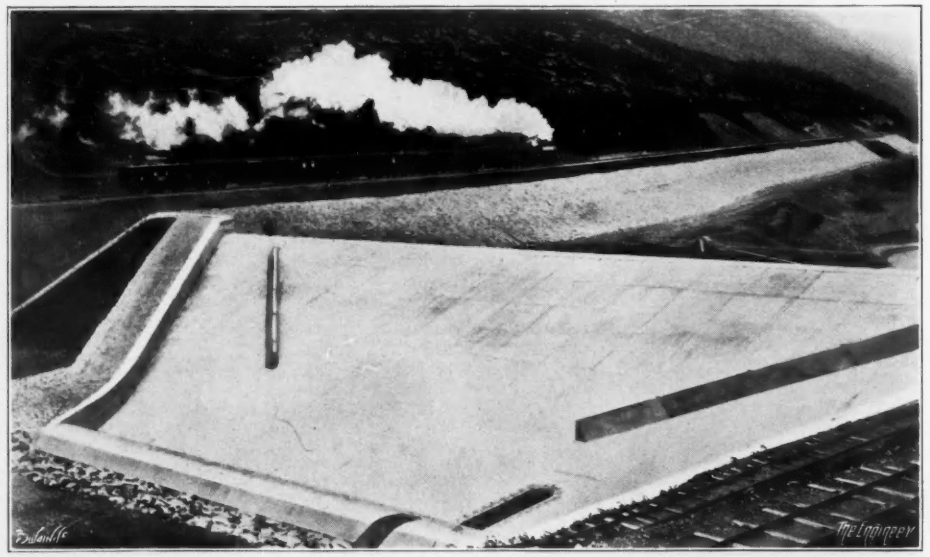
ABOVE:—THE BARENDRECHT VERTICAL LIFT BRIDGE
BELOW:—THE NEWPORT (TEES) VERTICAL LIFT BRIDGE

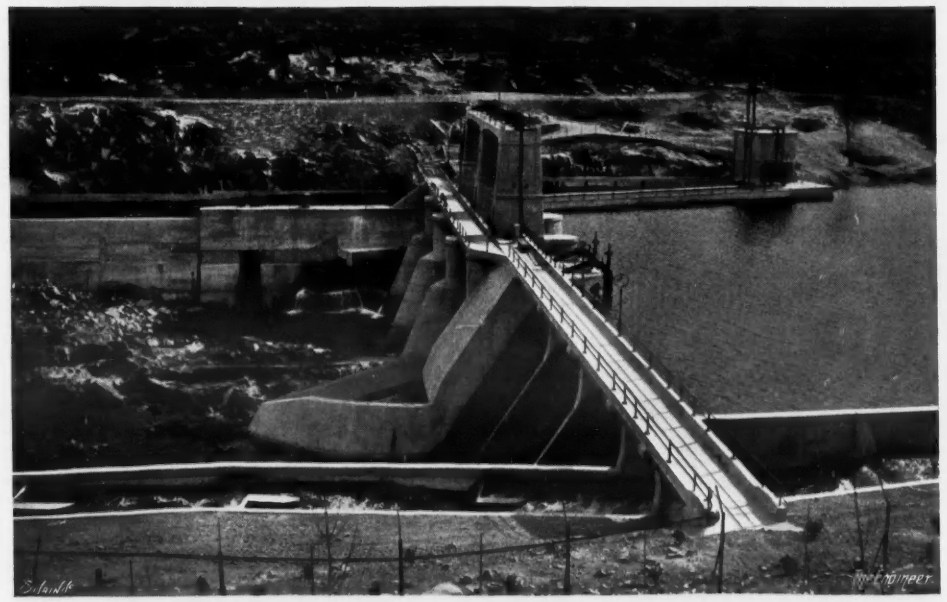
THE MERSEY TUNNEL COMPLETED IN 1934

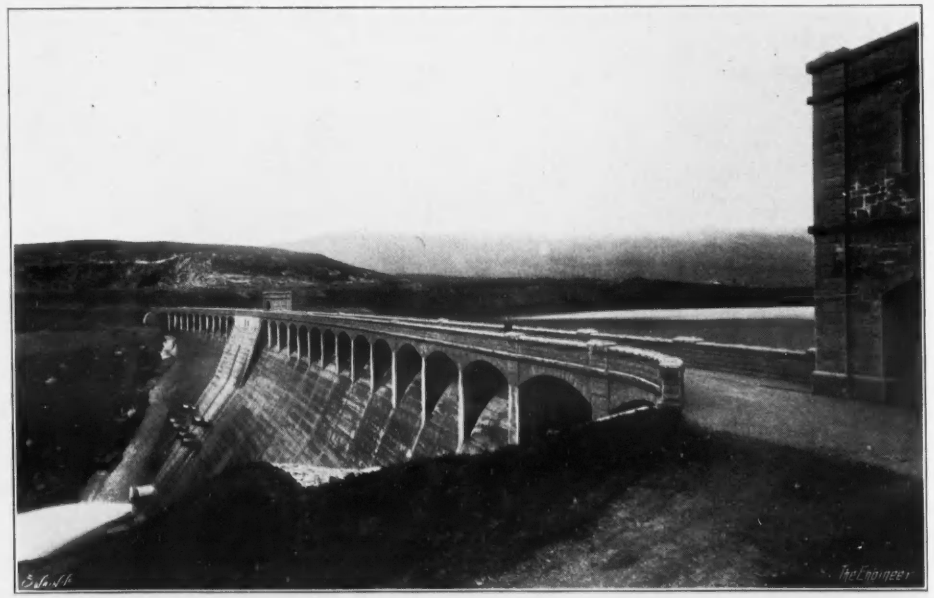
ABOVE:—ROADWAY OF COMPLETED TUNNEL
BELOW:—LINING FOR UPPER HALF OF 44-FT. TUNNEL

ABOVE:—JUNCTION OF MAIN AND BRANCH TUNNELS
BELOW:—STEEL REINFORCEMENT OF ROADWAY SLAB

DAMS FOR SCOTTISH HYDRO-ELECTRIC POWER IN 1934

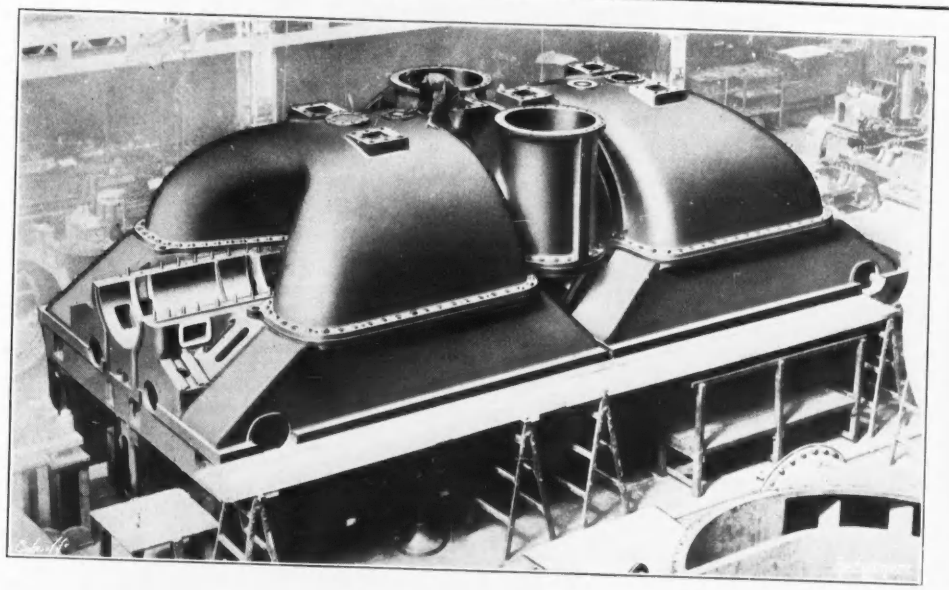


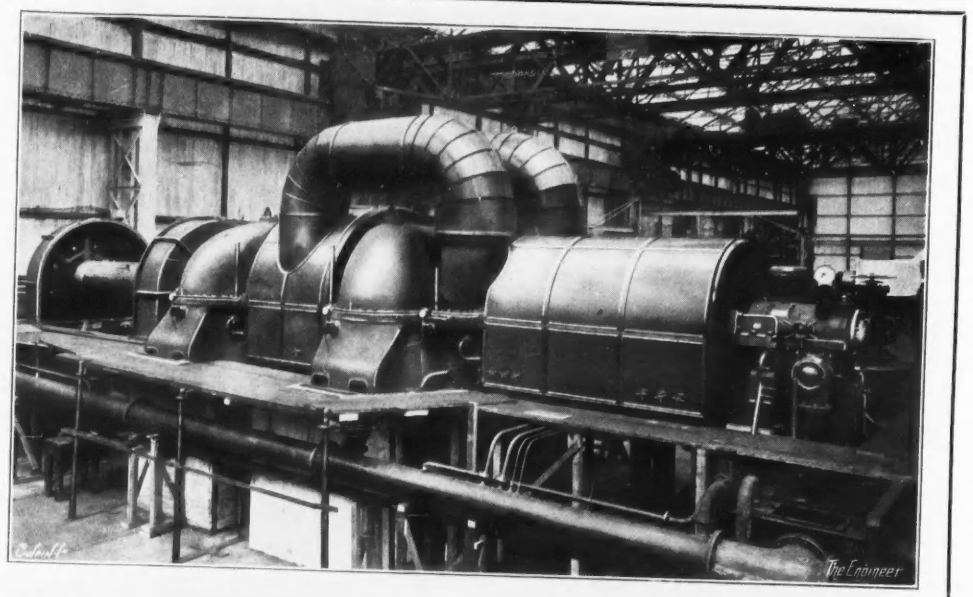


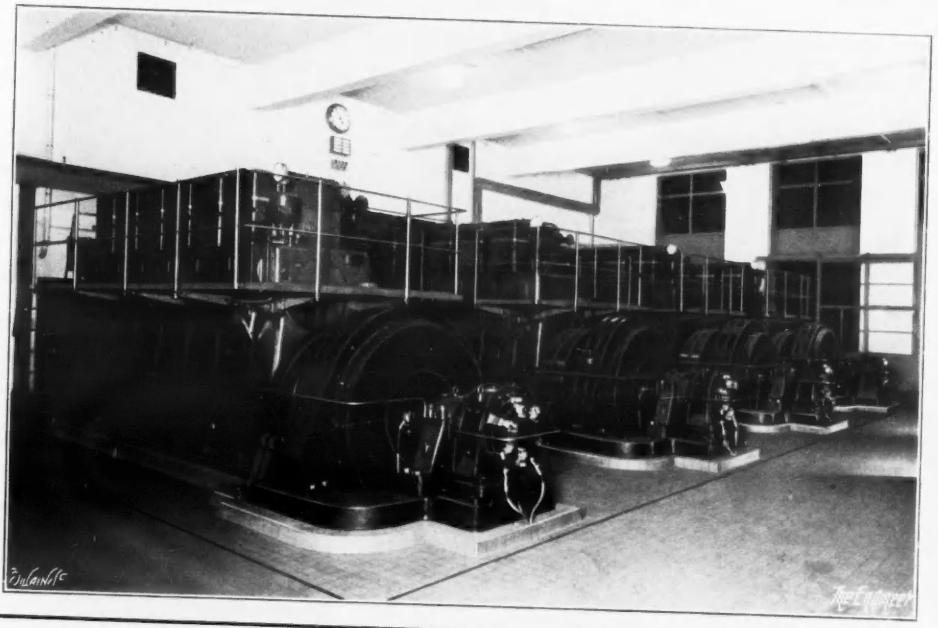


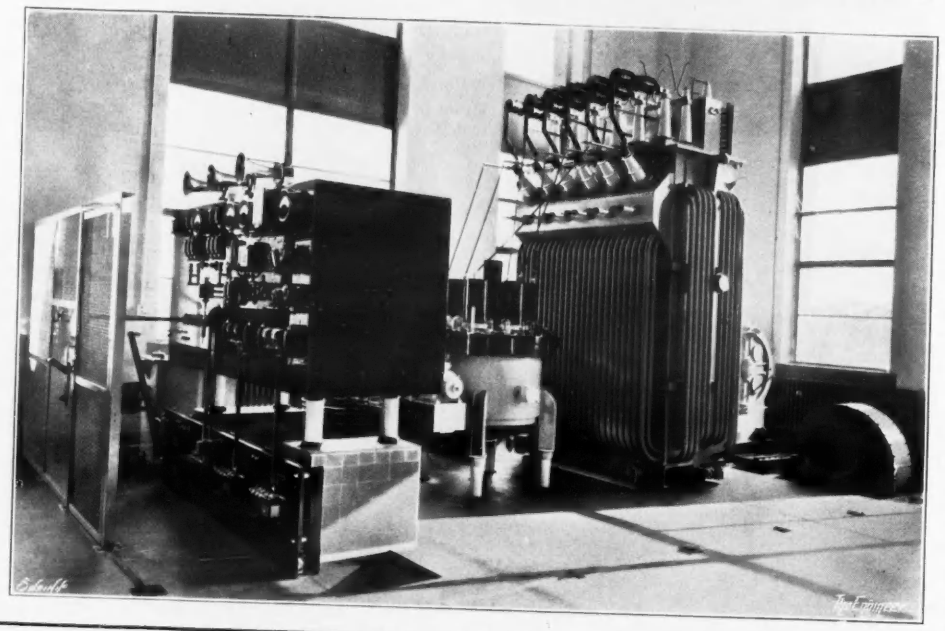
ABOVE:—GALLOWAY: THE CLATTERINGSHAWS DAM
BELOW:—GRAMPIAN: DUNALASTAIR INTAKE DAM

ABOVE:—LOCHABER: THE TREIG DAM
BELOW:—LOCHABER: THE LAGGAN DAM









ABOVE:—LOW-PRESSURE CYLINDER FOR 105,000 KW TURBINE FOR BATTERSEA—METROVICK
BELOW:—OIL-ENGINE GENERATING SETS AT THE DROITWICH BROADCASTING STATION—ENGLISH ELECTRIC

ABOVE:—30,000 KW TURBO-GENERATOR SET FOR THE TIR JOHN NORTH POWER STATION—PARSONS
BELOW:—RECTIFIER EQUIPMENT AT THE DROITWICH BROADCASTING STATION—B.T.H.

The Engineer

JANUARY 4, 1935.

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Contents.

THE ENGINEER, January 4th, 1935. PAGE

A SEVEN-DAY JOURNAL ... 1
AERONAUTICS IN 1934. No. I. (Illus.) ... 2
BRIDGES AND TUNNELS OF 1934. (Illus.) ... 4
SHIPBUILDING AND MARINE ENGINEERING IN 1934. No. I. (Illus.) ... 6
HYDRO-ELECTRIC POWER SCHEMES IN 1934. (Illus.) ... 10
THE PHYSICAL SOCIETY'S EXHIBITION. No. I. (Illus.) ... 11
ROAD AND RAIL ... 13
MISCELLANEA ... 13
AIR AND WATER ... 13
LEADING ARTICLES—
A Retrospect ... 15
LOCOMOTIVES AND RAILCARS OF 1934. (Illus.) ... 16
LITERATURE ... 17
SHORT NOTICES ... 17
BOOKS RECEIVED ... 17
NAVAL CONSTRUCTION IN 1934. (Illus.) ... 18
HARBOURS AND WATERWAYS IN 1934. No. I ... 21
LETTERS TO THE EDITOR—
High Rupturing Capacity Fuses ... 22
SIXTY YEARS AGO ... 22
ELECTRICAL ENGINEERING IN 1934. No. I. (Illus.) ... 23
WATER SUPPLY AND SANITARY ENGINEERING IN 1934. No. I. ... 25
CALENDARS ... 26
BRITISH STANDARDS INSTITUTION ... 26
PERSONAL AND BUSINESS ANNOUNCEMENTS ... 26
CONTRACTS AND ORDERS ... 26
MARKETS, NOTES AND NEWS ... 27
CURRENT PRICES FOR METALS AND FUELS ... 28
FRENCH ENGINEERING NOTES ... 29
BRITISH PATENT SPECIFICATIONS. (Illus.) ... 29
FORTHCOMING ENGAGEMENTS ... 30

TWO FOUR-PAGE SUPPLEMENTS—AERONAUTICS, STEAM AND MOTOR SHIPS, LOCOMOTIVES, BRIDGES, TUNNELS, DAMS, AND ELECTRICAL ENGINEERING IN 1934.

NOTICES TO READERS.

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A Retrospect.

IT may, we think, be said of 1934 that it was a "happy" year; a year without a history. In it the progress of recovery which began in 1933 continued, and no untoward event checked the slow upward movement of industry. Great Britain, indeed, became the object of wonder to a world still struggling to free itself from bonds and restrictions which it itself has riveted to its own limbs. In America, in particular, the recovery of the Old Country was watched with surprise, and with that admiration which the American always gives generously to success. It is but a few years since the United States spoke mournfully of the future of the "Old Country," and exhorted it to send to them for experts to show it how industry could be kept permanently and automatically at the highest level. Now, their tune is changed, and it is said, playfully, that America is thinking of inviting British economists to show her how to "muddle" out of the difficulties and depression in which she is involved.

Once again Great Britain has won through, and other nations, unwilling to admit that there may be some ill-understood science in her method—or apparent lack of method—are astonished by her success. It has been achieved with but little conscious planning, and without the economic and social upheavals which have accompanied the efforts of other nations to lift themselves out of the morass by their own boot-straps. It cannot even be said with absolute certainty that the one economic change of great magnitude made in the United Kingdom in recent years—the abandonment of free trade—is mainly responsible for the revival of industry. That is a factor which must, of course, be taken into account, but there are not wanting reasons for believing that even had that step not been taken, Great Britain would still have been the first nation to escape from the cloud of depression. In America they say that our revival is due to our phlegmatic temperament. They may be right. It is not for us to judge. Nor, whilst so much distress still remains, can we boast that the course we have pursued is entirely successful. All we can say, all we can claim, is that by an apparent lack of method we have achieved more than other nations which have worked, and are working, to preconcerted plans. We know that to tidy minds an opportunist or *laissez faire* policy is repugnant. They would like to see everything neatly arranged in advance, forgetting, perhaps, that there are forces against which not the greatest foresight in the world can adequately provide. America came up against one of those forces when, under the National Recovery Act, it presented labour with a club to wield against employers and capital. With that club labour practically broke the plan devised by Mr. Roosevelt. He counted upon the whole nation striving as one man to put industry on its feet again. He had failed to allow for human rivalries and animosities, and he has seen his ingeniously devised scheme wrecked by a force which he, inadvertently, liberated. We may be forgiven for suspecting that had America been less in a hurry to recover, she would now be in at least as good a position as this methodless Old Country. For this, at least, cannot be denied, that whatever its faults and shortcomings, the *laissez faire* policy, which people call muddling through, is instantly adaptable to whatever occasion may arise. It does not depend upon a rigid postulated sequence of events, and for that reason it avoids disaster when facts do not justify expectations. It is better to bend to the wind than break under it.

Yet, withal, it is a difficult year, in the realm of engineering, to say much about. That is natural in a period of convalescence. Not until full energy has been restored may we expect to see new efforts made. There was not, so it is said, any tightness of money during 1934, but there was still a difficulty, which continued to hamper foreign trade, in getting payment from foreign nations, and with taxation still far too great at home, private buying did not reach a high level. Yet with exchange values nominally against us, but actually in our favour, many firms saw their order books filling up and prices reached a level which promised some measure of profit. Consequently, employment improved and led, as the year advanced, to a strange condition. The dislocation of labour caused by the long months of slackness became evident. Skilled labour grew scarce, for whilst many mechanics had gone into other occupations, others who had been long out of work had lost their morale. They were not work-shy, but shy about their work. This psychological effect will gradually disappear, and it is probable that before long employers' complaints of the difficulty of securing skilled men will cease. But the difficulty may recur when the decrease in numbers of apprentices indentured during the depression begins to make itself felt. Three or four years hence, the years '32 and '33 will not yield the crop of journeymen which should be required at that time. Moreover, a further difficulty has arisen. Men who had been trained to engineering but have taken to other vocations under the pressure of necessity are remaining in them because the pay is better. That is a chronic trouble from which it is difficult to see a means of escape. There is no engineering employer who does not admit that the wages of mechanics are, by comparison with those in some other industries, on the low side. They would raise them if they could, but, with few exceptions, the nature of the industry is such that any increase in basal rates is impossible at the present time. However, "conversations" still continue between the Engineering Employers' Federation and the engineering unions. They are being conducted on friendly, reasonable lines, and there is, we rejoice to say, no hint of a rupture. Whilst the unions very naturally press their claims, we believe they are not blind to the fact that the difficulties of the employers are such that those claims cannot be granted in present circumstances.

During the year there was a continuation of the discussion on the "six-hour" day or "forty-hour" week, but it went no further, and, fortunately, there is no indication that the present Government will attempt to interfere in the matter.

The condition of employment is still far from satisfactory. Great improvement took place during the year, but there are still over two million unemployed persons on the register. If, in the present year, one million more find work, it will be a very notable advance. But we dare not anticipate such a rapid revival of industry, and shall have cause to congratulate ourselves if a few hundred thousand more hands are required. Hence, there remains the probability that the support of unprofitable people will remain a burden upon industry for several years at least. The fact that nearly all the other nations of the world are in the same plight, may, in the end, prove to be the salvation of all. For every one of these nations must sooner or later awake to the fact that it is undermining its own career by excessive nationalism. The effort that is being made by all nations to make sure of their home markets is destroying their foreign commerce and leaving them, on the whole, worse off than before. In the opinion of many economists what is now needed is a general lowering of tariff walls. Inter-foreign trade should be nurtured, not smothered. This country has always upheld that policy. But on the principle that to deal with lepers you must be a leper yourself, she abandoned it a few years ago, in the hope that when all nations were in the same condition all would agree to a modification of their protective duties. France did a little during the year to improve her foreign trade, but, as a matter of fact, little progress was made towards an end from which so much may justly be hoped. To the United Kingdom, with its huge mercantile marine, the recovery of international trade is of the first importance. Open the doors of the markets of the world, and we shall hear no more about subsidies to tramp steamers. Do that and find a stable basis for the world's currencies, and the road to recovery, long obscured by fog, will begin to open before us.

Iron and Steel Trade.

No industrial event of the year caused more discussion in certain circles than the conclusion of the efforts of the iron and steel trades to reorganise themselves on a new basis in conformity with the Government's demand that they should do so or be deprived of the protection afforded by a high duty on imported ferrous materials. For months the nature of the organisation was in dispute, but agreement was reached in April and the British Iron and Steel Federation was constituted. There then remained only the selection of an independent chairman, and it was not till November that that office was filled by the appointment of Sir Andrew Duncan, a lawyer by training, and until recently chairman of the Electricity Board. It is far too early to say how the scheme will work out, but on the strength of its prospects a demand for an advance of the import duty from 33 per cent. to 50 per cent. was advanced in July and is still under the consideration of the Import Duties Advisory Committee. That Committee leans towards a better understanding with the International Steel Cartel, and in view of the fact that the request for increased duties is not unanimous, may refuse to consider it.

Thames and Mersey.

Amongst the civil engineering works of the year two stand out—one because it put a summary end to a long-drawn-out controversy, and the other because it is the greatest of its kind in the world. We need scarcely say that we refer to the demolition of Waterloo Bridge and the completion of the Mersey Tunnel. The final chapter in the long history of the failure of Rennie's famous structure will be found on another page. Three or four years must pass before the next chapter can be written, for not till then will the new structure, of concrete with stone facing and a perfectly level crown, be completed. Whether it will satisfy the æsthetic sense as the old bridge did for over a century no one can say. Pictorially, it has not the charm of the old and has all the severity of modern architecture based on an armoured concrete *motif*. Originally the prime designer—Sir Giles Gilbert Scott—included decorative details, pylons and flights of steps, but they have been swept away either by a concession to modern art, which lacks faith in its ability to be ornamental, or, more probably, under the compulsion of economy. In one respect, as an illustration on another page shows, the design includes a bold conception and as a whole the structure should give reasonable satisfaction to the Port of London Authority and other river interests which would be only completely satisfied by an invisible span supported on shore piers alone.

The Mersey Tunnel is one of those works that keep the promoters in suspense until the last minute. Up to the very moment of the opening there were those who declared that it would be a white elephant and that it would be a continual and useless burden on the municipalities. As a matter of fact its success has far surpassed the best that its most ardent advocates anticipated, and the utilisation of a passage which it was intended to leave idle in order to save further expense is already being debated. The popularity of the Mersey Tunnel has raised again the question of

Thames tunnels, and since the demand for better cross-river connection below London Bridge is becoming more and more insistent, it is not improbable that before many years have passed a work of the kind will be undertaken. Indeed, it can scarcely fail to assume an important place in the survey of London traffic which Col. C. H. Bressey—made a Knight of the Order of the British Empire in the New Year's Honours—has been instructed by the Minister of Transport to undertake.

Transport.

A variety of problems connected in one way or another with transport occupied a great deal of attention during the year. Amongst them first place must be given to the question of human safety upon the thoroughfares of the Kingdom. With an average weekly death-rate approaching 125, and of non-fatal casualties of some 4000, it is impossible to regard the accidents, on a purely statistical basis, as but an insignificant fraction of the population of the country. The percentage is very small, but the actual number is much too great. With a very laudable effort to reduce it the new Minister of Transport, Mr. Hore-Belisha, introduced the marking of pedestrian crossing places, first by painted chevrons, subsequently replaced in many areas by stainless steel studs, and later by yellow globes mounted on the summits of steel poles. The thoroughness with which this procedure was pursued tended somewhat to defeat its object, for in crowded streets the globes occur at embarrassingly frequent intervals. Whilst everyone showed anxiety to assist Mr. Hore-Belisha in his effort the "beacons" came in for a good deal of adverse criticism, and the opinion seems to be growing that they are hardly worth while. The very practical suggestion has been made that if the studs were arranged in groups parallel with the axis of the road—instead of in two transverse lines, as at present—they would, owing to their projected length, be visible to the motorist a good distance away, and would serve all the purpose that is, or may be, achieved by the "orange-groves." It has to be admitted with sorrow that little reduction in mortality or injury has been effected by these efforts. For ourselves, we have urged that a scientific examination of accidents should be made, and we published on October 5th, 12th, 19th, and 26th a series of articles in which Mr. Dudley W. Walton indicated the lines upon which a statistical inquiry should be carried out. These articles attracted attention in high places, and are in some measure responsible perhaps for the decision of the Ministry of Transport, announced a few days ago, to collect the necessary data for the detailed examination of all road accidents in future.

Another outstanding event of the year in the realm of transport was the air race from England to Australia. Notable in itself by reason of the speed with which the winning machine covered the distance of 11,300 miles, it is, perhaps, more notable because of the agitation which it aroused for the improvement of British air services. We discussed that agitation in a couple of leading articles—see THE ENGINEER, November 16th and November 30th—and endeavoured to show that it was partly based on a misunderstanding of the position. But the main fact remains that there is still ample scope for the further development of aeronautics and aeronautical services in this country. As we are happy to show on another page of this issue this need is being met. During the year there was a large increase in the activities of firms building aero-engines and aircraft, and the demand for civil machines is increasing. The interest which is being taken in non-standard types, like the Pterodactyl and the Autogiro, is an indication of the vigour of the young industry.

In the ambit of marine transport the year was one rather of expectation than realisation. Shipbuilding improved somewhat, but the shipping industry is still in such a deplorable condition that a special scheme for the encouragement of tramp steamer services has been adopted by the Government. Several interesting developments in marine engineering must be placed to the credit of the year and will be found recorded in our review of the work of the year, but all other events were overshadowed by the successful launch of the great new Cunarder—the "Queen Mary"—on September 26th. The decision to proceed with the building was only reached on February 22nd, but the hull and all the appurtenances connected with it had been so carefully maintained that the vessel was ready to take the water by the Autumn. Since then, as a picture which we print in one of to-day's Supplement shows, she has made good progress, and it is anticipated that she will be ready for service in 1936. At the time of her launch the liveliest hopes existed that a sister would be ordered at once, but the year closed without the realisation of that hope.

On railways, the completion of one very notable steam locomotive—the "Cock o' the North"—and the beginning of another of the same class are events to be recorded with exceptional interest, for whilst the first of the engines is fitted with poppet valves the second is to have piston valves. As the two engines are identical except from an enlargement of the superheater in the "Earl Marischal"—the second of the class—instructive comparisons should be available. The oil engine-propelled locomotive or train made slow progress. We printed in our issue of November 30th an article reviewing the world position. It showed that, whilst much has been done, much remains to be accomplished before the requirements of standard railways can be satisfied. The electrification of British railways—other than the Southern—advanced hardly at all, but at the end of the year an Electricity Supply Bill, which seems to aim, indirectly at least, at the realisation of the Weir report, passed its third reading in the House of Commons.

Machine Tools.

We must not conclude this condensed review of a few of the prominent occurrences of 1934 without mention of the Machine Tool Exhibition at Olympia. Both as an indication of the progress which has been made in the design and construction of machine tools, and as an example of what an exhibition should be, it left nothing to be desired. All the principal exhibits were described in our columns; but, furthermore, we took the unusual course of inviting an expert works manager to discuss critically the qualities, merits, and defects of recent designs.

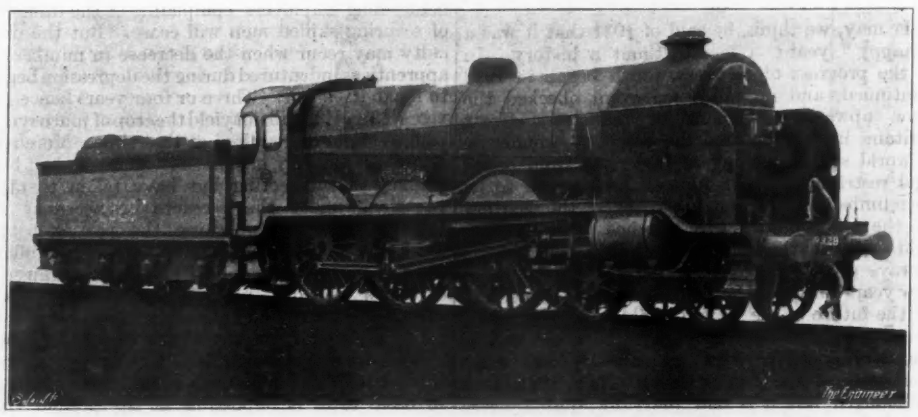
Locomotives and Railcars of 1934.

THERE is no doubt about the principal locomotive of 1934. It is the "Cock o' the North," designed by Mr. H. N. Gresley for the Scottish services of the L. and N.E. Railway. There are many interesting things about it; not the least being that it was sent in December to be tested on the locomotive testing plant at Vitry, near Paris, certainly the finest plant of the kind in the world (see THE ENGINEER, November 10th, 1933). In this country there is no plant capable of dealing adequately with an engine of the size and power, but, that deplorable fact apart, there is a certain fitness in the tests being carried out in France, for Mr. Gresley acknowledges the influence of recent French practice on the design; and in one important respect, the employment of a twin funnel with the "K.C." blast pipe of the Paris-Orleans Railway, the French design has been closely followed.

But there is yet another thing about "Cock o' the North" that adds to the interest. She is fitted with poppet valves and A.L.E. R.C. actuating mechanism, whilst a sister, the "Earl Marischal," recently completed, has Walschaerts gear for the two outside cylinders and a floating lever for operating the inside valve, as in Mr. Gresley's "Pacifics." She was also built in Doncaster and is, save for the difference in valve gear, and an increase of superheater surface—776·5 square feet against 635·5 square feet—obtained by using larger tubes, indentical with her predecessor. The piston valves are 9in. diameter with a maximum travel of 5⅝in. and a steam lap on the outside cylinders of 1 $\frac{9}{16}$ in. and on the inside cylinder of 1⅜in. There is no exhaust lap and the maximum cut-off is 65 per cent. The "Cock o' the North" is illustrated in one of our plate Supplements to-day and her sister is shown in the accompanying portrait. The former was fully described in our issue of June 1st, when special attention was paid to the boiler and the cylinders. Both engines take the standard L.N.E.R. high-sided "Pacific" type tender.

Another locomotive which appears in our Supplement is a 4–6–0 mixed traffic engine for the L.M.S., one of seventy, of which fifty were ordered from the Vulcan Foundry Company, and the remainder are being built at Crewe. The class has been aptly described as "general utility." The cylinders, two in number, are 18½in. by 28in., fitted with long travel, 6½in., valves operated by Walschaerts gear. The wheels are 6ft. in diameter and the tractive effort at 85 per cent. b.p. is 25,455 lb. The total loaded weight of the engine and tender is 114 tons 14 cwt.

The Southern Railway is going slow on locomotive construction in view of the extensive electrification of the system, but amongst more or less routine work an interesting job was carried out in the conversion of Mr. L. Billinton's famous "Baltic" tank engines into tender engines, as shown in the accompanying illustration of the "Stephenson." This has involved the removal of the trailing bogies and the shortening of the frames, while the height of the chimney and dome has been reduced and a new cab to conform to the composite loading gauge of the Southern Railway has been fitted. These engines will now be able to run on any main lines other than the Tonbridge to Hastings section, whereas their former dimensions and limited tank capacity restricted them to three or four routes of the old Brighton system now under electrification. A standard 5000-gallon double-bogie tender has been provided, resulting in a total wheel base of 57ft. 6in. for engine and tender, and a length of 66ft. 11¾in. over buffers. The other leading dimensions are unaltered, the cylinders being 22in. diameter by 28in. stroke, driving wheels 6ft. 9in. diameter, total evaporative heating surface 1816·6 square feet, superheater surface 383 square feet, and grate area 26·7 square feet. With 180 lb. per square inch boiler pressure the tractive effort is 25,600 lb., or 11·4 tons at 85 per cent. The adhesive weight is 55 tons 9 cwt., that of the engine 73 tons 2 cwt. in working order, and the combined weight of engine and tender fully loaded 130 tons 13 cwt.



S.R. CONVERTED BALTIC TANK ENGINE

Two of these engines already bear names, and opportunity is being taken to name the rest after famous locomotive engineers of the past, which, together with No. 2333, "Remembrance," will form what is to be known as the "Remembrance" class, as under:—No. 2327, "Trevithick"; No. 2328, "Hackworth"; No. 2329, "Stephenson"; No. 2330, "Cudworth"; No. 2331, "Beattie"; No. 2332, "Stroudley"; No. 2333, "Remembrance."

The middle illustration in our Supplement shows a quite different type of steam locomotive. It represents an effort made by a non-standard locomotive building firm to meet the problems of oversea railway operation, where heavy loads have to be hauled on steep gradients with sharp curves. The remarkable characteristics of this engine are the use of a water-tube boiler of the "Woolnough" type and no less than six separate compound engines, each gear-coupled to one of the six axles on which the engine is carried. These locomotives—there are three of them—built by the Sentinel Waggon Works, Ltd., for

Colombia, S.A., are made for the metre gauge and can exert a tractive effort of 17,500 lb. Their total length is some 43ft., and owing to the arrangement of the bogies they can round curves of 80 m. radius. The working pressure is 550 lb. The engines have 4¼in. and 7¼in. by 6in. cylinders, and the gear ratio is 2·74 : 1. For starting boiler steam is admitted to the l.p. cylinders automatically, but at a reduced pressure. The first of these very ingenious locomotives was fully described in our issue of June 15th, where particular attention was paid to the design and workmanship of the motor units, which exhibit many excellent and interesting points. The same company has recently completed a shunting engine of a totally different design, with which we hope to deal fully at an early date.

Amongst oil-engined locomotives, of which a fair number was built during the year, but none of large size, we may mention an oil-electric engine by R.[illegible] and W. Hawthorn, Leslie and Co., Ltd., and the English Electric Co., Ltd. It develops 300 h.p. and is suitable for shunting and heavy haulage. It weighs 47 tons in running order and on wheels 4ft. 0½in. diameter can exert a tractive force of 30,000 lb. The engine and generator are combined in a neat unit and for the first time the English Electric Company's torque control system was applied to a locomotive. The general principle involved in this device is that the engine speed is kept at a pre-selected value by varying the electrical loading to suit the load on the draw-bar. The control is entirely automatic and was described in our issue of June 8th.

On the Chemin de Fer du Nord, Monsieur Lancrenon carried out some interesting experiments during the year with the Cossart valve. Monsieur Cossart is the Chief Works Engineer of the Nord. It is an unfortunate thing that the French use "piston valve" for something different from what we mean by the term here, with the result that some misunderstanding about the Cossart valve has arisen. It really resembles a double piston-drop valve, or, in other words, a double poppet valve without seats. Fifty suburban engines are already fitted with this gear and two old "Pacific" compounds are being converted to two cylinder, single-expansion engines, with this distribution. We understand that so far the results are considered very satisfactory, as the efficiency of the engines and their freedom of running are increased. The question of maintenance is now being studied, and since, by the replacement of springs by steam pressure for the movement of the valves, one of the objections to the gear has been removed and its action improved, good results are anticipated.

The Nord is also experimenting with the Lemaitre multiple blast pipe, which has one central and four lateral jets, the former being variable by an internal "olive." Research into the best adjustment has shown that with a back pressure of 300 grammes at the cylinder a vacuum of 245 mm. of water is secured in the smoke-box.

Railcars.

Since, as recently as November 30th, we published an article by a correspondent dealing with "Progress in Oil Engine Traction," which was concerned particularly with the progress of railcars in various parts of the world, there is little need to enter fully into a discussion of what has been done in that field during the last year. We think, therefore, it will be sufficient if we mention here two typical examples of designs brought out in this country during 1934.

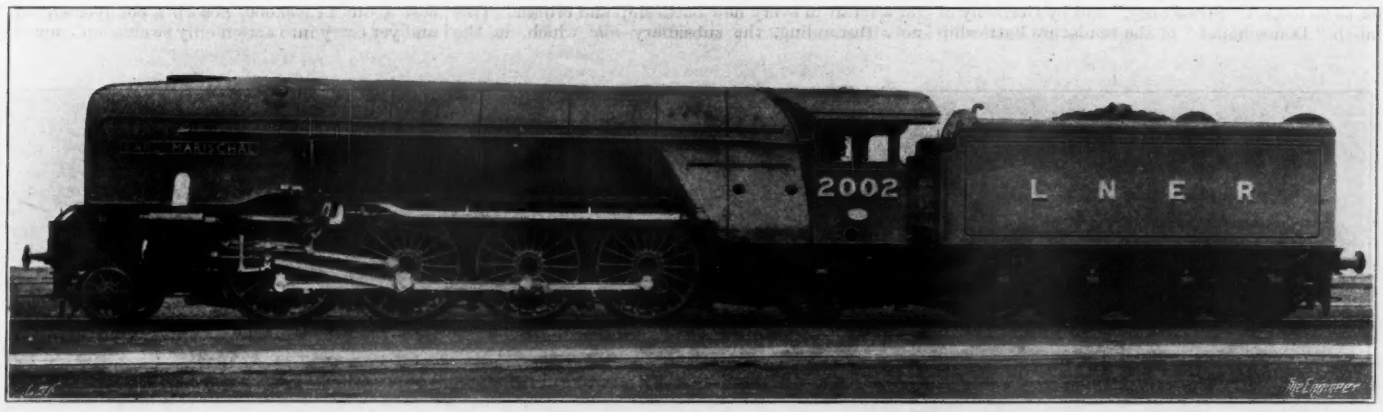
At the end of June we described and illustrated the chassis of three railcars built by the Associated Equipment Company, Ltd., for the Great Western Railway. The design of these cars is a development from that of the single vehicle put into service in the Reading district in the previous year. Each vehicle has two 130 h.p. engines mounted one on each side of the chassis. One of these engines drives one of the axles of the leading bogie through a fluid fly-wheel, while in the transmission system of the other, which drives both axles of the rear bogie, there is a Wilson preselective gear-box besides the fluid fly-wheel. As the railcars are intended for express service, acceleration is not of great importance. By the arrangement adopted one of the engines only does the greater part of the work in gathering speed, the other being required in order that this speed may be maintained and so that there shall be adequate power in hand. We need not refer to all the details of the design of these vehicles. They entered service at the end of July, running as expresses between Birmingham and Cardiff on a schedule allowing about 2 h. 20 min. for the journey. At first, as is to be expected with a new design, a number of "teething troubles" developed, but there was nothing of a fundamental or otherwise serious nature. For a short period the railcars were withdrawn, but as from September 25th last they have been running continuously. What few minor troubles there have been are traceable frequently to the inexperience of drivers and others concerned in the running of the vehicles. A short while ago the "local" railcar operating in the Reading district was overhauled after covering approximately 46,000 miles by its makers. It was found, we understand, to be in excellent condition. That the railway company is satisfied with the performance of the railcars may be inferred from the fact that three more cars similar to, but not identical with, those operating between Cardiff and Birmingham are, we understand, on order, and that orders for further cars are under consideration.

At the end of February, 1934, we described an interesting vehicle produced by Leyland Motors, Ltd., for the L.M.S. Railway. Designed for secondary and branch line service, it is given a capacity for high acceleration, actual figures provided by the makers being as follows :—

Rest to : 20, 30, 40, 50 m.p.h.
Time : 11, 20, 32, 49 sec.

The vehicle is unusual in that it is mounted on only two axles. It weighs 10¼ tons and carries forty passengers. In the fully laden condition its power/weight ratio is 10 h.p. per ton, and its maximum speed, governed, 56 m.p.h. The 130 h.p. six-cylinder oil engine is mounted beneath the floor in the centre of the car, and it drives one of the axles through a hydraulic torque converter similar to the one we described in our issue of October 13th, 1933.

Three of these vehicles have been in service on the L.M.S. during the year, and apart from teething troubles have given satisfactory service.



L.N.E.R. THREE-CYLINDER PASSENGER LOCOMOTIVE

Literature.

The Testing of Bituminous Materials. By D. C. BROOME, F.C.S., M. Inst. P.T. London : Edward Arnold and Co. 1934. Price 15s.

THIS orderly and well-illustrated book, which is one of "The Road-maker's Library" series, is correctly described, in the sub-title, as being a laboratory handbook, concerning road and building materials, and it is wholly devoted to laboratory practice. Its author shows himself fully competent to provide written instruction for laboratory workers, and to inform chemists, engineers, and architects on this subject. The descriptions of the tests are clearly given, with instructive discussion of alternative methods and of characteristics, whether those of the material under test, the method described, or a particular form of apparatus, which call for special consideration.

While a book whose author is a research chemist of Mr. Broome's qualifications will readily be accepted in the laboratory, those engineers and architects who rely upon the chemist in respect of the qualities of materials in this class, and have some knowledge of testing, may wish to know whether descriptions of recently introduced instruments and methods are to be found in the volume, and whether consideration is given to such methods as are not usually met with in books relating to the employment or testing of bituminous materials.

Both questions may be answered in the affirmative. In the first of the two sections relating to the testing of constituent materials, the many methods for the determination of viscosity which are described include that by which it is measured in scientific units. Two pages on electrical testing suffice for descriptions of three of the most important of such determinations. In the chapter on physical tests on aggregates, there is a description of the photo-electric turbidimeter, used in a new method for determining the particle size and size distribution of a mineral filler, in regard to which the author observes that "... it is thought that the method is worthy of serious consideration."

In the second section, relating to the testing of finished mixtures, an important chapter on the determination of soluble bitumen contains a description of the photo-bitumeter, used in a method described as extremely rapid and accurate. Mr. A. R. Thomas' apparatus for the measurement of rolling attrition, which resembles that evolved some years ago in the Italian Road Testing Laboratory, is described at some length. Contributed by Mr. R. O. Child, a very interesting chapter on the testing of roofing felts completes the section. In appendices are a number of tables and a bibliography giving the references from 187 numbered passages in the text.

SHORT NOTICES.

The Principles and Practice of Surveying. Volume 2, *Higher Surveying.* Fourth edition. By C. B. Breed and G. L. Hosmer. New York : John Wiley and Sons ; London : Chapman and Hall, Ltd. Price 21s. 6d. net.—Several sections of this book have been rewritten and much new material has been added. Chapter I contains new matter on triangulation instruments and methods, curvature and refraction problems, calculation of triangulation, and on rectangular co-ordinate systems. More general field methods of observation have been added to the second chapter, and the matter of interpolation has been made to accord with the latest issue of the American Ephemeris. The section on precise levelling has been rewritten and portions of the text dealing with aerial surveying have been revised.

BOOKS RECEIVED.

The "Rapid" Total Weight Calculator. London : Gall and Inglis, 13, Henrietta-street, W.C.2. Price 1s. 6d. net.

High-Voltage Physics. By L. Jacob, M.Sc. London : Methuen and Co., Ltd., 36, Essex-street, W.C.2. Price 3s. net.

Statistical Appendix to Minerals Year-book, 1932–33. Washington, D.C.: Superintendent of Documents. Price 1·00 dollar net.

L'électricité dans L'usine. By P. Monnier. Paris : Les Presses Universitaires de France, 49, Boulevard Saint Michel. Price 40f. net.

Regulations for the Electrical Equipment of Buildings. Tenth edition. London : E. and F. N. Spon, Ltd., 57, Haymarket, S.W.1. Price 1s. 6d. net.

Worm Gears. By A. B. White. London : The Association of Engineering and Shipbuilding Draughtsmen, 96, St. George's-square, S.W.1. Price 2s. net.

Automatic Protection of A.C. Circuits. By G. W. Stubbings, B.Sc. London : Chapman and Hall, Ltd., 11, Henrietta-street, W.C.2. Price 15s. net.

Lubricating Oil Tests and their Significance. By J. E. Southcombe, M.Sc. London : Germ Lubricants, Ltd., 735, Salisbury House, E.C.2. Price 2s. 6d. net.

Jane's Fighting Ships, 1934. Edited by O. Parkes, O.B.E., M.B. London : Sampson Low, Marston and Co., Ltd., 100, Southwark-street, S.E.1. Price £2 2s. net.

Railways for All. By J. F. Gairns. Revised and enlarged by J. K. Taylor. London : Ward, Lock and Co., Ltd., Warwick House, Salisbury-square, E.C.4. Price 6s. net.

Konstruktion und Werkstoff der Geschützrohre und Gewehrläufe. By Professor Dr. W. Schwinning. Berlin : V.D.I. Verlag, Doretheenstrasse 40, N.W.7. Price 13·50 rm.

The Man Who Built the "Mauretania" : The Life Story of Sir George B. Hunter, K.B.E., D.Sc. By W. Rutherford. London : Hillside Press, 3, Lansdowne-road, W.11. Price 7s. 6d. net.

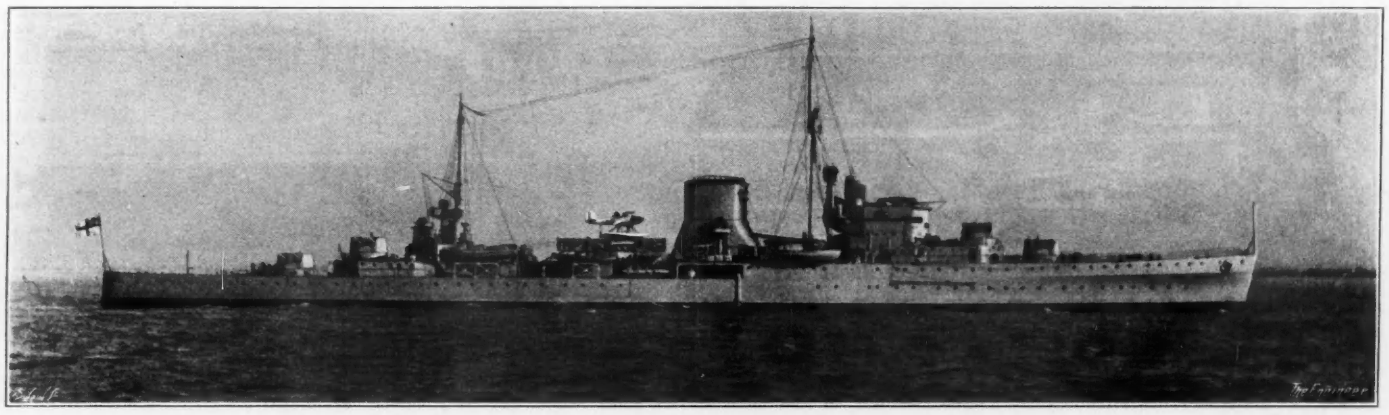
The "Practical Engineer" Electrical Pocket Book and Diary for 1935. Edited by Conrad Arnold, A.M.I.E.E. London : Oxford University Press, Amen House, Warwick-square, E.C.4. Price 2s. 6d. net.

Naval Construction in 1934.

By HECTOR C. BYWATER, A.I.N.A.

THE volume of new naval tonnage begun in 1934 exceeded by a very substantial margin that of any previous year since 1921–22, when the Washington Treaty went into effect. Nor is this the only reason why the past year was noteworthy, for it witnessed the laying down by Italy of what promise to be the two largest battleships in the world. Whereas the "Nelson" and "Rodney," the heaviest battleships now afloat, are of 33,500 and 33,900 tons respectively, Italy's new ships are designed for the full "standard" displacement of 35,000 tons. Two further events of importance were the commencement by France of a second battle-cruiser of the 26,500-ton "Dunkerque" class, to be named "Strasbourg," and by Germany of a fourth "Deutschland" of the miniature battleship type, which has aroused so much interest in technical circles. In all, 106,000 tons of capital ships were begun during the year under review. For all practical purposes, therefore, the "holiday" in this type of construction is at an end. Unlike France and Italy, neither the British Empire, the United States, nor Japan has any margin of replacement tonnage in this type of vessel, and all three are therefore debarred from building new capital ships until the year 1937.

The negative result of the London naval talks initiated last summer, reopened in October, and adjourned just before Christmas, renders more probable the general resumption of capital ship construction two years hence. There are, indeed, many indications of an international revival of interest in sea power. This does not necessarily imply a recrudescence of the bellicose spirit in world affairs. Rather is it the logical sequel to the protracted and, it is to be feared, sterile proceedings at the Geneva Disarmament Conference. In the absence of any definite or practicable scheme of collective security the nations are quite naturally turning back to the old system of defensive armament, which, for good or ill, has prevailed ever since mankind became organised in communities. From yet another point of view the increased activity in naval construction is significant. In spite of an intensive propaganda designed to make the nations air-minded, every Power with maritime pretensions is paying more and more attention to its naval forces. This can only mean that the responsible heads of defence departments have struck a just balance between the possibilities and the limitations of the air arm. The fundamental difference between air power and sea power is that the former is local and circumscribed, the latter world-wide and illimitable. That air force will play a very important part in future naval warfare is acknowledged by all responsible students of strategy. This new element is already influencing naval architecture. In many, if not most, modern ships special protection has been provided against air bombs, and there is a growing tendency to equip bridges and exposed control positions with bullet-proof plating against the contingency of machine gun attack by low-flying aircraft. Furthermore, the aircraft carrier is becoming an indispensable component of every well-found fleet, and naval constructors are now expected to provide accommodation for aircraft in every new battleship and cruiser. This notwithstanding, the subsidiary *rôle* which, in the judgment of the highest naval authorities at home and abroad, the air weapon is destined to play in naval operations is emphasised by the steady production of ocean-going men-of-war whose principal arm is the gun.



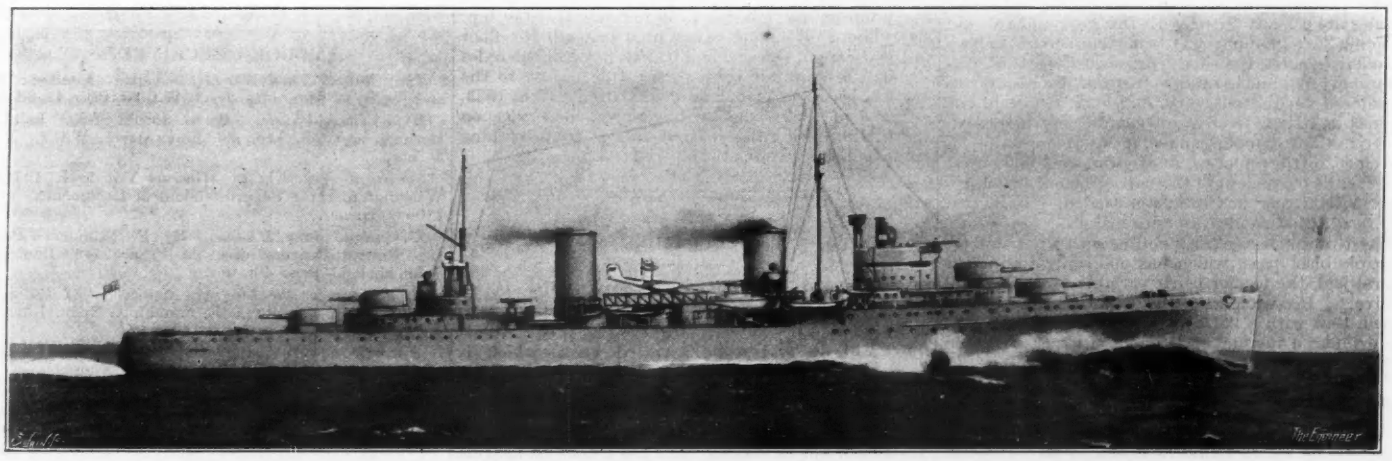
H.M. CRUISER "NEPTUNE"

The British Empire.

During the late autumn work was begun at John Brown and Co.'s Clydebank yard on H.M.S. "Southampton," and at the Vickers-Armstrong's Walker-on-Tyne yard on H.M.S. "Newcastle." These two ships, originally designated "Polyphemus" and "Minotaur," are the first of the 9000-ton type which the Admiralty, much against its will, was forced to adopt to maintain the balance against the large cruisers now building in American and Japanese yards. They belong to the revised 1933 programme, the third cruiser of which is the "Penelope" of the 5200-ton "Arethusa" class. Three further "Southamptons"—"Glasgow," "Sheffield," "Birmingham"—and one "Arethusa" type comprise the 1934 programme. The "Sheffield" is to be built by Vickers-Armstrongs at Walker (the machinery at their Barrow works); the "Glasgow," including machinery, by Scotts, of Greenock; and the "Birmingham" at Devonport Dockyard (the machinery by John Brown and Co., Clydebank). In all, therefore, five cruisers of the "Southampton" class are building or on order. By naval officers these vessels are regarded with mixed feelings. While there is general approval of the Admiralty's decision to build ships approximately equal in power to their foreign contemporaries, it is felt that a 9000-ton ship, carrying only 6in. guns, is needlessly large. Here, however, the Admiralty's hands are tied by London Treaty rules. The new American cruisers of the "Savannah" class displace 10,000 tons and are to be armed with fifteen 6in. guns. The Japanese "Mogami" class are of 8500 tons and will mount fifteen 6·1in. guns.

H.M.S. "Southampton" and her four consorts represent a more conventional design. The water line length is 584ft., the beam 61ft. 8in., and the draught 17ft. The machinery will be geared turbines fed by four Yarrow boilers and driving four screws, the speed being at least 32 knots. Twelve 6in. guns in triple turrets, two forward and two aft, will form the main armament. There will also be four 4in. A.A. guns, eight torpedo tubes, two seaplanes, and a catapult. As in the "Leander" and "Arethusa" types, vertical armour is worked over the 'midships section, but over the greater part of the ship protection is limited to an armour deck or decks. The drawbacks to the "Southampton" design are obvious. Each ship will cost about £1,900,000, absorb a complement of 700, and yet carry into action only twelve 6in. guns with a broadside fire of 1200 lb. The area of target is very large and inadequately protected against gunfire, though the under-water defence should be superior to that of the 10,000-ton "County" cruisers, which are notoriously sensitive "below the belt." In ordinary circumstances the Admiralty would certainly not have evolved the "Southampton" design. As it is, it has had to plan within the artificial framework of a limitation treaty which has the anomalous effect of forcing navies to build ships larger and more expensive than are necessary for the normal duties they will be called upon to perform. On the other hand, the "Southampton" promises to be a weatherly ocean cruiser of great steaming endurance, and as such should prove an efficient guardian of trade.

H.M.S. "Arethusa," completing at Chatham, is due to begin her trials in April. Authorised under the 1931 Estimates, she was not launched before March of last year. Two sisters are in construction, the "Galatea," by Scotts, of Greenock; and the "Penelope," by Harland and Wolff, of Belfast. A fourth ship, "Aurora," is to be built at Portsmouth. The type has a water line length of 500ft., a beam of 51ft., and a draught of 13ft. 10in. on a displacement of 5200 tons. It is propelled by geared turbines taking steam from four Yarrow boilers, the designed s.h.p. being 64,000 and the speed 32·25 knots. Twelve hundred tons of oil can be carried. There is a patch of belt armour covering about two-fifths of the hull length, but it is doubtful if this plating is stout enough to resist the impact of 6in. shell except at extreme range. It should, however, be useful as a burster and also as protection against splinters. The "Arethusa's"



H.M.A. CRUISER "SYDNEY"

armament comprises six 6in. guns in twin turrets, two forward and one on the quarterdeck; four 4in. A.A., eighteen small guns, and six tubes on triple mountings. Criticism has been directed against this type on the ground that it is the smallest and most feebly-armed cruiser now under construction in any country. Without doubt the "Arethusa" cuts an unimpressive figure alongside such vessels as the French "Jean de Vienne" or even the "Emile Bertin" (5886 tons, 34 knots, nine 6in. guns), the Italian "Condottieri" group, or the German "Leipzig." She is apparently intended to serve as a fleet cruiser or alternatively as a convoy escort, and would be useful in either capacity. The type does, however, constitute a departure from the sound principle that every British warship must be approximately equal in fighting power to foreign vessels of equivalent type and date. The "Arethusa's" fuel oil stowage is only 150 tons more than that of the "D" class cruisers, but with her more economical machinery her radius of action should be considerably larger than that of the older ships During the year the cruisers "Achilles," "Orion," and "Neptune" joined the Fleet. They are units of the "Leander" class, which has been fully described in these columns. Although inclined to be lively in a seaway, they are, on the whole, excellent ships, if unduly expensive. They are understood to average £1,600,000. In proportion to their size, 7140 tons, they have extraordinarily good accommodation, especially for the ratings, and in other respects, such as workshop space and equipment, they represent a great advance over preceding cruiser types. On her "shake-down" voyage last year the "Achilles" steamed from Gibraltar to Portland at an average slightly in excess of 28½ knots. The fifth and last vessel of the group, the "Ajax," was launched at Barrow on March 1st. All three ships of the "modified Leander" type, "Amphion," "Apollo," and "Sydney," are in the water. The last named, originally authorised as H.M.S. "Phæton," has been transferred to the Royal Australian Navy and re-named to commemorate the R.A.N. cruiser that made history during the Great War. In this class there is a wider spacing of boilers and engines than in the "Leander" and a reversion to two funnels.

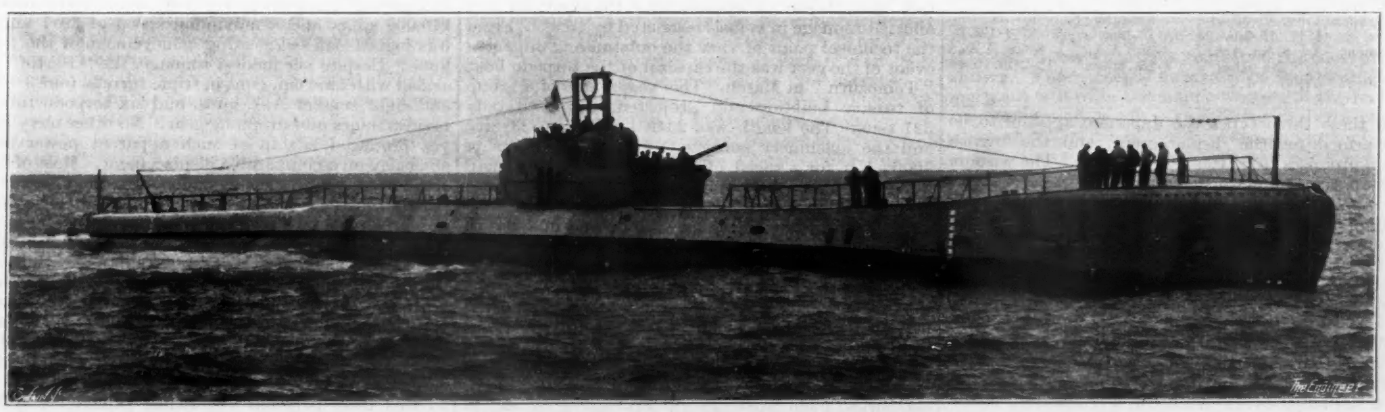
How seriously treaty restrictions are cramping our cruiser policy and substituting artificial types for those best suited to the needs of British strategy is shown by a cursory survey of current construction. Although pinned down to a definite and very limited total of cruiser tonnage, we are simultaneously producing three types—one of 9000 tons with twelve 6in. guns, one of 7140 tons with eight 6in. guns, and one of 5200 tons with six 6in. guns. The fact that no other Power which signed the London Treaty has been placed in a similar dilemma furnishes the best proof that the British Empire was committed to a singularly bad bargain. In a desperate effort to maintain a reasonably adequate cruiser force on the 91,000 tons allotted to the Empire for the six years ending December 31st, 1936, the Admiralty resorted to ships inferior in tonnage and armament to those building abroad, piously hoping that our example would lead to a universal cut in cruiser dimensions. That hope proving illusory, they were compelled to produce the 9000-ton "Southamptons." Meanwhile, the other interested Powers, untrammelled by such unilateral handicaps, have continued to build ships adapted to what they consider to be their special requirements. This irrational state of affairs cannot continue indefinitely. Every intelligent citizen of the Empire must hope that when next the Powers meet in conclave to determine the future scale of relative strength at sea, British interests will be safeguarded more adequately than they have been at past conferences. The interests of national defence transcend, or ought to transcend, all other considerations. That they are paramount in other countries is made plain by a survey of current naval construction abroad.

The flotilla leader "Exmouth" and her flock of eight "E" class destroyers were completed during the year, and have since joined the Home Fleet. Displacing 1375 tons, the "E" destroyers are identical with the preceding class in all respects save fuel supply. This has been slightly increased, with the result that the new boats have an endurance of 6000 miles at economical speed. This radius is unequalled by any foreign destroyers except those building in the United States, which are somewhat larger. The decision to increase steaming endurance rather than add to the armament or strive for the sensational speeds credited to French and Italian boats is undoubtedly wise. Actually, however, the "E" boats have all improved upon their contract speed of 35·5 knots, several making 38 knots on full-power trial. The "Esk" and "Express" of this class are equipped for mine-laying. In the flotilla leader "Exmouth" the displacement is increased by 100 tons to meet the demand for extra staff accommodation and to provide an additional 4·7in. gun and half a knot more speed. No fault is to be found with our present destroyers. They are just large enough for high seas work, speed and armament are adequate, and in sea worthiness and steaming endurance they are unexcelled. The "F" boats of the 1932 programme are passing into commission; those of the "G" group are well in hand, and most of the "H" class (1934 programme) have been laid down. This promptitude in starting new construction is a refreshing contrast to the inordinate delays of the past.

At the time of writing the only important unit of the 1934 programme not yet ordered is the aircraft-carrier "Ark Royal." Under Treaty regulations her displacement is bound to exceed 10,000 tons, but no details of the ship are available. Submarine construction is proceeding normally. Three distinct types are represented in current programmes—the "Thames" class for overseas work, of 1805–1850 tons on the surface, a speed of 22–22½ knots, and an armament of one 4·7in. or 4in. gun, two smaller pieces, and six tubes; the "Porpoise" minelayer class, 1500 tons, 15 knots, armed as the "Thames," but carrying mines in addition; and the "Swordfish" class of coastal boats, 670 tons, 13¾ knots, two small guns and six tubes. Including those of the 1934 Estimates, the following submarines have been completed, laid down, or ordered in the past two years:—Three "Thames," four "Porpoise," eleven "Swordfish."

H.M. "E" CLASS DESTROYER "ESCAPADE"

Six sloops were provided in last year's Estimates, raising to thirty-three the number of these vessels authorised since 1927. The majority conform to the original "Bridgewater" class, 1045–1060 tons, 16½ knots, two 4in. or 4·7in. guns; but two new types are now in hand, the convoy sloop "Enchantress" (ex-"Bittern") and the coastal sloop "Kingfisher." Contrary to expectation, the "Enchantress" displaces only 1170 tons, and her original armament of four 4·7in. guns has been reduced to three in order to provide the additional cabin space necessitated by her selection for occasional use as an Admiralty yacht. The speed is 18 knots. As first planned, this vessel could be regarded as the germ of the powerful convoy sloop of which the Navy, desperately short of regular cruisers, stands urgently in need. Many naval officers advocate sloops of approximately 2000 tons, mounting at least two 6in. or 5·5in. guns, in place of the existing types, whose sole value in war would be as minesweepers. Ships not exceeding 2000 tons, with speeds limited to 20 knots and not more than four 6in. guns, are exempt from Treaty restriction. It is much to be hoped that one or more such vessels will be included in the 1935 Estimates. Not one of our existing sloops could stand up to a surface or submarine raider mounting 6in. guns, and no official explanation has been offered for the spending of millions on what are virtually non-combatant units. A net-layer and target-towing ship, presumably similar to H.M.S. "Guardian," 3050 tons and 18 knots, is to be built by contract under last year's programme and to be named "Protector"



H.M. "THAMES" CLASS SUBMARINE "SEVERN"

United States.

After long delay the United States is now proceeding with characteristic energy to build up a fleet of full treaty strength. Under the N.R.A. statute

enormous sums have been set aside for naval construction, ship modernisation, and naval works. Ships are being built by the score, and with the sole exception of submarines all are designed for the maximum tonnage and armament sanctioned by treaty. Of the fifteen capital ships, all have been or are to be completely reconstructed at a cost of £2,000,000 to £3,000,000 per ship. Of special interest is the work just completed on the battleship "New Mexico." She was the first of her type to have turbo-electric drive, a system which apparently gave satisfaction. Now, however, she has been re-engined with geared turbines which have raised her speed from 21 to 22½ knots. It will be interesting to see whether the remaining "electric" battleships—"California," "Tennessee," "Colorado," "Maryland," "West Virginia"—are also to be converted to turbine drive. Thanks to this extensive process of modernisation, the U.S. battle fleet is, without doubt, superior to every other in general war efficiency.

Considerations of strategy are responsible for the American policy of building only cruisers of the largest dimensions permitted by treaty. Liable to be called upon to operate in waters far distant from the American coast, where no friendly bases are likely to exist, the U.S. naval command very naturally attaches prime importance to seaworthiness and cruising radius. All new vessels, therefore, have a very large fuel oil capacity, part of which is intended to replenish the bunkers of destroyers in an emergency. It may be mentioned in passing that the refuelling of destroyers at sea from tankers, capital ships, and cruisers is now a routine practice in the U.S. fleet.

Thirteen out of the eighteen 10,000-ton cruisers with 8in. guns allotted to the United States under the London Treaty are either completed or on trial; two more, "Tuscaloosa" and "San Francisco," are completing afloat; the "Quincy" and the "Vincennes" are on the stocks, and the last ship, "Wicheta," is to be started early this year. All are, nominally, of 10,000 tons, though weight-saving devices have, in most cases, cut several hundred tons off this figure. The contract speed of all is 32½ knots, and with the exception of the first pair—"Pensacola" and "Salt Lake City," which carry ten 8in. guns in two triple and two double turrets—the standard armament is nine 8in. in two triple turrets forward and one aft, with eight 5in. anti-aircraft guns. The first eight ships each mount six torpedo tubes, but in later vessels this armanemt is omitted—wisely, in the writer's opinion. Each cruiser carries two catapults and four seaplanes, much ingenuity having been displayed in housing the machines. In the adaptation of aircraft to naval purposes the United States is easily first.

Of equal interest are the seven cruisers of the "Savannah" class, all of which have been laid down. Their details will be found in the subjoined table, where they are compared with the new British and Japanese 6in. gun cruisers of large tonnage :

	U.S.S. "Savannah."	H.M.S. "Southampton."	I.J.N. "Mogami."
Laid down ..	1934	1934	1933
Length, feet ..	600	584	625
Breadth, feet ..	61·7	61·8	59·6
Draught, feet ..	19·9	17	15
Displ., tons ..	10,000	9,000	8,500
Speed, knots ..	32·5	32 (?)	33
Armament	15–6in. 8–5in. A.A. No tubes	12–6in. 4–4in. A.A. 8–2in. tubes	15–6·1in. 8–5in. A.A. 12–21in. tubes
Aircraft	4	2	3

Of these three types the Japanese appears to be over-armed for the displacement, and the British vessel promises to be the best sea boat. The wisdom of mounting so powerful an armament as that of the Japanese and American types in high-speed cruisers of necessarily fine lines has yet to be demonstrated.

The aircraft-carrier "Ranger," launched in February, 1933, was commissioned in May last year. Her principal data are: Waterline length, 728ft.; beam, 80·2ft.; draught, 19·8ft.; displacement, 14,500 tons; geared turbines of 53,500 s.h.p., speed 30 knots; armament, eight 5in. A.A. No less than seventy-two aircraft can be accommodated in this ship, the majority, no doubt, in a dismantled condition. In speed trials off the Virginia Capes she earned for her builders (Newport News Shipbuilding Company) a bonus of £10,000 by exceeding her contract speed. Last November, however, she was withdrawn from service for a long refit, and it has since become known that her immense lay-out of petrol tanks, containing fuel for the seventy-two aircraft she carries, must be replaced. In order to save weight the tanks were built of a light steel supposed to be corrosion-proof. It has been found, however, that the tetra-ethyl lead contained in this special "anti-knock" petrol was causing severe corrosion. Two new carriers, "Yorktown" and "Enterprise," are on the stocks at Newport News—length, 762ft.; breadth, 83·2ft.; draught, 21·9ft.; displacement, 20,000 tons. Their completion will give the U.S. Navy five carriers with a minimum collective speed of 30 knots and a total stowage capacity of nearly 400 aircraft.

The "Farragut," first of the U.S. post-war destroyers, was launched in March. She belongs to a group of thirty-six boats completing or building, all of 1500 tons and 37 knots, armed with five 5in. guns, eight lighter A.A. pieces, and eight 21in. torpedo tubes. Ten flotilla leaders are also building. They displace 1850 tons, have a speed of 37 knots, and carry the same armament as the "Farragut" destroyers; but their cruising radius is 8000 miles, as compared with 6000 miles for the smaller vessels.

Ten submarines are constructing, all of 1300 tons surface displacement. For the U.S. Coastguard Service, which becomes an integral part of the Navy in war, seven "cruising cutters," or sloops, have been laid down. They deserve notice because they are just the type of ships that would be so useful to the British Navy for convoy purposes. They are 328½ft. in length, have a speed of 20 knots, and a radius of 8000 miles. Two 6in. guns are mounted, but supports are provided for another pair of such guns. Provision is made for carrying a seaplane.

Last month the following ships were actually under construction or completing for the U.S. Navy :—

Two 20,000-ton aircraft carriers,
Four 10,000-ton cruisers with 8in. guns.
Seven 10,000-ton cruisers with 6in. guns.
Ten 1850-ton flotilla leaders,
Thirty-six 1500-ton destroyers,
Ten 1300-ton submarines,
Seven 2000-ton cutters or sloops with 6in. guns.

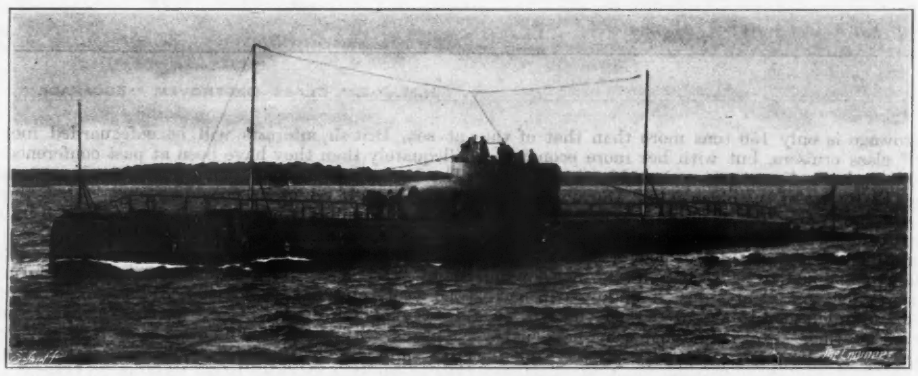
Japan.

The largest ships launched during the year were the 8500-ton cruisers "Mogami," "Mikuma," and "Sudzuya," details of which appear in a preceding table. Three additional vessels of this type are on the stocks. Two aircraft carriers, each of 10,000 tons, are to be started early this year, and it is understood that about twelve destroyers and ten submarines are already building. Special types also in hand include twelve torpedo boats of the "Tomozuru" class, a 5000-ton minelayer with I.C. engines, and the submarine depôt ship "Taigei," of 10,000 tons, also motor driven, with a contract speed of 20 knots. The marked concentration on special types—minelayers, aircraft tenders, miniature torpedo craft, &c.—is doubtless due to the fact that Japan is approaching the limit of her allotted tonnage in vessels restricted by treaty. From the technical point of view the outstanding Japanese event of the year was the capsizal of the torpedo boat "Tomozuru" in March. This vessel, one of a group of twenty building and projected, displaced only 527 tons. The length was 254ft., the beam 23·8ft., and the machinery consisted of geared turbines of 7000 s.h.p. for a speed of 26 knots. Into this small hull had been packed an armament of three 5in. guns and four 18in. torpedo tubes, besides a light anti-aircraft gun. The 5in. guns were housed in splinter-proof turrets. As an attempt to extract the last ounce of fighting efficiency out of a small displacement the design was striking enough. Unfortunately, the "Tomozuru" encountered heavy weather on her first trip with the fleet and promptly turned turtle, drowning most of her company. The results of this disaster have been far-reaching. Not only in the class to which the lost ship belonged, but in several other categories, including cruisers, top-hamper is said to have been drastically reduced. The writer yields to none in his admiration for the skill and ingenuity of Japanese constructors, but readers who study the profiles of the Japanese 10,000-ton and 7100-ton cruisers, of the reconstructed battleships, and of the latest destroyers—*e.g.*, "Fubuki" and "Ariake" classes—cannot but agree that stability must have been gravely prejudiced by the piling up of top weights. The "Tomozuru" disaster may therefore prove to have been a blessing in disguise. An official *communiqué* from Tokio last month announced that the defects in design revealed by the "Tomozuru" affair had been rectified. Whether this applies only to the particular class affected or to other ships which are overburdened with deck weights is not made clear.

France.

On November 26th the keel of the battle-cruiser "Strasbourg" was laid at the Penhoët Yard, St. Nazaire. This vessel is to be a replica of the "Dunkerque," shortly to be launched at Brest and described in last year's review. Corrected details are :—Length overall, 685·8ft.; beam, 102ft.; draught, 28·1ft.; displacement, 26,500 tons. Parsons geared turbine of 100,000 s.h.p., six Indret boilers, contract speed 29½ knots. The strongest belt armour is 8·7in., but there are two protective decks and a longitudinal armoured bulkhead. The thickness of the turret armour has not been disclosed. Protection accounts for 10,000 tons of the total displacement. The two quadruple turrets armed with 13in. guns are placed forward, the rear one superposed. Of the sixteen 5·1in. guns forming the secondary armament twelve are in quadruple and four in twin turrets. All these guns are understood to be on high-angle mountings, and there are, in addition, forty smaller pieces. In the grouping of main and secondary armament the "Dunkerque" and her sister reveal the influence of the "Nelson" design, while another feature borrowed from British practice is the huge control tower. The next French capital ships promise to be of greater tonnage and heavier armament, conforming to the 35,000-ton Italian vessels which were begun in October.

The most important French unit completed during the year was the cruiser "Algérie," seventh and last of the 10,000-ton "Washington" class. This ship differs from her predecessors in having fairly robust protection, and is, in fact, virtually an armoured cruiser, though the belt is believed not to exceed 4in. The designed speed is 33 knots. Eight 8in. guns of a new model are mounted in the usual four turrets and the anti-aircraft battery has been increased to twelve 3·9in. guns. With her single funnel and massive control tower the "Algérie" presents a formidable appearance, which is probably justified by her fighting qualities. Even more remarkable, technically, is the minelaying cruiser "Emile Bertin," which ran her trials some months ago. This ship is 548ft. in length, has a beam of 52½ft., draws 16·4ft., and displaces only 5886 tons. She is propelled by four sets of Parsons single-reduction turbines fed by six Penhoët boilers and developing 102,000 s.h.p., the contract speed being 34 knots. Her trials were signally successful. At full power her engines developed 110,000 s.h.p. and a maximum speed of 39·7 knots was logged—an engineering achievement of the first force. Despite her modest tonnage, the "Bertin" is armed with nine 6in. guns in triple turrets, four 3·5in. and eight smaller A.A. guns, and six torpedo tubes, besides mines and dropping gear. No other navy has yet produced a ship of such apparent power and efficiency on a comparable displacement. Most of the six "Fantasque" flotilla leaders are afloat and preparing for their trials. Displacing 2569 tons, they are the largest of their type which have been built to date. As in the two immediately preceding groups, the turbine machinery is of 74,000 s.h.p. and the contract speed 37 knots. In all France has built or has on the stocks thirty-two of these very large "contre-torpilleurs," which by London Treaty rating are cruisers. Whatever their tactical value may be, they are splendid craft as regards design, workmanship, and behaviour at sea. The writer can testify to this from personal experience gained last year. The twelve "escorteurs," or high-speed torpedo boats, ordered in 1933 are still under construction. Length, 236·2ft.; displacement, 600 tons; turbines of 22,000 s.h.p. for 35 knots; armament, two 3·9in. guns, four 16in. torpedo tubes; radius, 1800 miles at 18 knots. These vessels should be decidedly useful for anti-submarine work. In the past two years submarine construction has been slowed down, only two boats being included in the 1934 programme. The 669-ton submarine minelayers "Le Diamant" and "Perle" have been completed. Completing afloat are the four coastal boats of the "Minerve" class, 571 tons, and the six ocean-going vessels of the "Agosta" class, 1379 tons. Including boats building, the French navy now possesses eighty-one submarines under the age limit, by far the largest undersea flotilla in existence.



THE PORTUGUESE SUBMARINE "DELFIM"

Italy.

Interest centres in the two battleships "Littorio" and "Vittorio Veneto," which were laid down on October 28th, the former by Ansaldo at Genoa, the

latter at the San Marco yard, Trieste. By a recently published decree, the particulars of new warships are not to be disclosed until official sanction is given. Consequently, nothing is known about the new capital ships, except that they are to displace 35,000 tons. In view of the acknowledged skill and ingenuity of modern Italian naval architects, details of the "Littorio" and her sister are awaited with keen interest. The battleships "Cavour" and "Cesare," launched in 1911, are undergoing extensive reconstruction. Originally they displaced about 21,750 tons, were engined with Parsons turbines of 24,000 s.h.p. for 22 knots, and were armed with thirteen 12in. guns and eighteen 4·7in. New turbines and boilers are being installed to increase the speed to 26 knots; the amidships 12in. triple turrent has been suppressed, reducing the main armament to ten 12in., and the 4·7in. battery has been replaced by twenty-four 3·9in. guns on high-angle mountings. The "Bolzano," seventh and last of the 10,000-ton cruisers, is now in service. She resembles the Franch "Algérie" in having increased protection, but is much faster, her machinery developing 150,000 s.h.p. for 35½ knots. On an eight hours' full-power trial she achieved a mean of 38 knots. Four cruisers of the improved "Condottieri" class were put afloat during the year:—"Montecuccoli" and "Muzio Attendolo," 5857 tons, 110,000 s.h.p. for 36½ knots; and "Emanuele Filiberto" and "Eugenio di Savoia," 6791 tons, horse-power and speed not yet released. All four ships have an armament of eight 6in. guns, six 3·9in. A.A., and six torpedo tubes. Two sisters to the "Filiberto" class, "Giuseppe Garibaldi" and "Duca degli Abruzzi," are building. Completion of these ships will bring the strength of the "Condottieri" squadron up to twelve units, the fastest and most homogeneous light cruiser group possessed by any navy. The performance of these remarkable ships, several of which have reached a speed of 40 knots, reflects the highest credit on Italian engineering. Four destroyers of 1449 tons and 38 knots were completed last year, and four torpedo boats of 615 tons are about to undergo trial. The latter closely resemble the French "escorteurs" in speed, armament, and other characteristics. The large submarine programme introduced in 1930 is approaching completion. When it matures, Italy will have nearly sixty submarines under the age limit. They range from ocean-going units of 1368 tons to coastal boats of 590 tons, and include several minelayers. During the past year the "Sciesa" and "Toti," of the 1368-ton class, successfully completed a voyage of 15,000 miles round Africa.

Germany.

The third "armoured ship" of what is popularly known as the "pocket battleship" class was launched at Wilhelmshaven on June 30th under the name of "Admiral Graf Spee." It is reported, but not yet confirmed, that this ship and her successor, "Ersatz Elsass," will have geared turbines in place of the Diesel engines installed in the "Deutschland" and "Admiral Scheer." There have been complaints of excessive vibration and noise in connection with the propelling plant of the two last-named ships, but it is only fair to add that their general behaviour in service is highly praised by German experts. Furthermore, when the "Deutschland" visited the Firth of Forth last October she was inspected by many British naval officers and engineers, all of whom were genuinely impressed by the ship. The "Admiral Scheer," commissioned on November 12th, has a control tower instead of the stout foremast as fitted in the "Deutschland," but otherwise is identical with that vessel. Some surprise was occasioned by the announcement that a new German cruiser, "Nürnberg," had been launched at Kiel on December 8th. No previous intimation, official or otherwise, of the existence of this ship had been given, though her construction is well within the margin allotted to Germany under the Versailles Treaty. Presumably she is a sister to the "Leipzig," 6000 tons, which has been fully described in these columns. The "Leipzig" and "Königsberg" visited Portsmouth in July and evoked general admiration. British technicians fully appreciate the prowess of their German confrères in overcoming the disabilities imposed on naval design by Treaty restrictions. The small depôt ships or gunboats, "Saar" and "Tsingtau," propelled by Diesel engines and armed with three 4·1in. guns, have been completed.

Other Navies.

The Netherlands cruiser "De Ruyter," 6000 tons, contract speed 32 knots, seven 6in. guns, with 3in. belt armour, is building at Rotterdam. A new Netherlands flotilla leader, of about 2500 tons, has been authorised, and is to be laid down this year. The design is by Yarrow. The Greek Government has placed an order with Vickers-Armstrongs for two destroyers of the British "D" class, 1375 tons, 35½ knots, four 4·7in. guns, eight torpedo tubes. The sloops, destroyers, and submarines built in British yards for the Portuguese Navy have, with few exceptions, been delivered, and given satisfaction. A contract for destroyers from Brazil is believed to be impending. This slow but steady inflow of foreign naval contracts is an encouraging symptom of the times, and, incidentally, evidence of the high repute in which British shipbuilding is held abroad.

Harbours and Waterways in 1934.

No. I.

THE year 1934 saw the completion of a number of important dock and harbour works, both at home and abroad, although it is still unfortunately true that very few schemes of port extension in this country are now in execution, or even in prospect, and our somewhat pessimistic forecast of a year ago seems to be justified. Bills in Parliament relating to harbours and docks are again few in number and of minor importance. Practically all the dock works in this country whose inception was due to the policy of State assistance, which came to an end in the financial crisis of 1931, have now been brought to completion. During the year two outstanding figures in the world of port construction passed away. Sir Frederick Palmer died in April at the age of seventy-two; his connection with harbours and waterways began in 1901 as the engineer to the Calcutta Port Commissioners. As the first chief engineer to the Port of London Authority and later as consulting engineer, he was responsible from 1909 for a large part of the huge programme of capital works carried out by the Authority in the twenty years following its creation. Abroad, Sir Frederick was responsible, since the war, for the making of a number of new harbours in British Colonies and Protectorates, including those at Takoradi, in West Africa, and Haifa, in Palestine. Sir Robert McAlpine died in November at the age of eighty-seven. Head of the firm of public works contractors which bears his name, he had been associated for many years with Sir Frederick Palmer in carrying out the construction of port and harbour works, including a considerable share of the works for the modernisation of the Port of London.

There is little doubt that the progress of modernisation in the principal ports of the United Kingdom has reached a stage when the trade requirements of the present day have, on the whole, been fully met. In some of the largest of the home ports the existing facilities for shipping are more than sufficient, and in spite of some indications of world trade revival that happily have been apparent in recent months, it seems to us that the next few years are likely to be a period of marking time relatively to the development that has taken place in home ports in the past decade.

THE UNITED KINGDOM.

The Port of London.

The Port of London Authority on March 31st celebrated the twenty-fifth anniversary of its existence. Since the creation of the Authority in 1909 the port has been completely remodelled. Nearly 15 million pounds have been spent on capital account, in addition to over 5½ millions on improvements. The improvement of the deep-water channel has alone cost between 3 and 4 million pounds. The net tonnage of vessels that arrived in and departed from the port in 1909 was 38½ millions; in 1933 the corresponding figure was 56½ millions. It is interesting to recall also that when the Authority began its work the largest entrance lock in the port was one 695ft. long by 79½ft. wide, having a depth of water at high tide of 38ft. Now the largest of the locks which give entrance to the docks—one of the Tilbury locks—is 1000ft. by 110ft. and has a depth of 45½ft. at high water.

The works of improvement at present in hand are of relatively minor importance. New timber storage sheds are being erected at the Surrey Commercial Docks, and the Authority has given notice of a Bill in the present session of Parliament which, among other things, provides for further improvements in the Royal Victoria Dock and in the passage between that dock and the Royal Albert Dock.

The Mersey and the Manchester Ship Canal.

Another large sand pump hopper dredger is being built for the Mersey Docks and Harbour Board by Cammell, Laird and Co., Ltd., of Birkenhead. This vessel, which was launched on December 21st, will be almost exactly similar to the "Hilbre Island," to which we made reference a year ago. Both of these vessels are designed to dredge to a depth of 70ft. and to load 3500 tons of sand in fifty minutes.

A new wharf, 1100ft. long, has been built at Ellesmere Port, on the Manchester Ship Canal, for the use of Bowater's Paper Mills. The berths alongside the wharf are being dredged to a depth of 30ft.

North-East Coast and Humber Ports.

The fish dock at Grimsby, begun by the London and North-Eastern Railway Company in conjunction with the Corporation of Grimsby in 1930, was opened by Sir Henry Betterton, the former Minister of Labour, on October 4th. The water area of the fish docks has been increased by 37 acres and a total area of 175 acres has been enclosed by a river embankment, the reclaimed land being required for sidings and for future industrial development. The new dock, which has cost nearly £1,700,000, is equipped with slipways for the repair of trawlers and drifters, and there are three coaling jetties for the bunkering of fishing craft. We published in our issues of December 7th and 14th an illustrated description of the dock works.

No work on a large scale was carried out during the year at the London and North-Eastern Railway Company's coal shipping ports on the North-East Coast, but a good deal was done in the way of improving the details of coal shipping plants, particularly by the installation of additional anti-breakage appliances at Hull, Grimsby, and Blyth. In spite of the general trade depression in the export coal trade, the shipments of coal at Blyth in 1934 surpassed all previous records. Two new trawler slipways of the side-traversing type were brought into use during the year at the St. Andrew's Dock at Hull. The railway company has spent in the past two or three years over £100,000 on improvements in and the re-equipment of this dock, which is the centre for the Hull fishing fleet.

The Ayr and Calder Navigation is still engaged on the river training works at Trent Falls, begun about six years ago at the confluence of the rivers Trent and Ouse. The Navigation obtained in the last session of Parliament powers to extend the time for the completion of the training walls and authorising additional expenditure on the works.

The new Corporation deep-water quay at Sunderland was brought into use in October. The quay, which is situated in the river Wear near the entrance to the South Docks of the River Wear Commissioners, is 1062ft. long and has cost about £350,000. The river bed in front of the quay has been dredged to a depth of 30ft. at low water of spring tides, and on the quay a two-storey reinforced concrete warehouse and transit shed has been built. At one end of the quay is an electric coal conveyor, intended principally for bunkering purposes, which is capable of loading coal at a rate of 600 tons per hour, and there is an equipment of electric travelling cranes. The Corporation is now making provision for the oil bunkering of vessels using the quay, and an oil storage installation is being laid down for this purpose on land adjoining it. The quay is founded on reinforced concrete monoliths, sunk by compressed air, the superstructure being also of reinforced concrete. The River Wear Commissioners have undertaken the management of the quay on behalf of the Corporation of Sunderland.

The Tyne Improvement Commissioners towards the end of the year placed contracts for the building of new coal shipping staiths at Hebburn, which will be erected at a cost of approximately £100,000. The staiths, which will occupy a river frontage of about 1300ft., will provide accommodation for two vessels and will have a loading capacity of 1500 tons per hour from three fixed coaling towers, each fitted with a radial arm having a lateral travel of 95ft. The berths alongside the staiths are to be dredged to 25ft. depth at low water of spring tides and provision will be made for this depth to be increased to 30ft. in the future. These staiths will take the place of the old Springwell Staiths, and coal will be brought to the shipping points by belt conveyors. The wagon discharging point is to be situated about 1000ft. inshore of the staiths, the conveyor belts being installed in a covered gallery. Three electric hoists at the wagon discharging point will raise the empty wagons to the level of the running-off roads. The conveyor belts at the shipping towers can deliver coal at a maximum height of 65ft. above high water or 80ft. above low water at a distance of 60ft. out from the face of the staiths.

The dry dock at Wallsend which Swan, Hunter and Wigham Richardson, Ltd., have built at a cost of £250,000 was brought into use in September. Work was begun on the dock in February, 1933; it is 570ft. long internally and has an entrance 80ft. wide with 26ft. over the sill at high water of spring tides. A breakwater at the small fishery village of Seahouses, in Northumberland, which has been under construction for about two years, is now nearly completed. The structure is about 400ft. long and an expenditure of about £25,000 has been incurred.

Southern Railway Ports.

A year ago we recorded the opening by the King of the new dry dock at Southampton. At that time practically the whole of the new deep-water quay, which extends for a distance of nearly 1¼ miles between the site of the dry dock at Millbrook and the town of Southampton, had been completed. Two large transit sheds were already in use, and a beginning had been made with the erection of two other similar sheds. At the present time the whole of the transit sheds on the quay frontage, eight in number, are either completed and in use or in course of construction; the quay is finished and nearly the whole of the dredging alongside the wall and the filling of the reclaimed area has been completed. The dry dock, although it was inaugurated by the King in July, 1933, was not completely finished and ready to be used until some months later. The first vessel to enter the dock was the "Majestic," of 56,598 gross tons, on January 19th, 1934, when the pumping out of the dock occupied four hours. In October the first of the industrial

concerns to be established on the area of 400 acres of land that has been reclaimed between the new quay and the old line of foreshore, the flour mills for Joseph Rank, Ltd., was brought into use. The mills, which occupy an area of 2 acres, are situated about 200 yards from the quayside ; and, in addition to the buildings devoted mainly to milling, there is an eight-storey warehouse and a reinforced concrete silo of a capacity of about 15,000 tons of grain. Grain is discharged direct to the silos from vessels lying at the deep-water quay by travelling pneumatic plant on the quayside and belt conveyors on overhead gantries passing over the intervening space. The whole of the new buildings have been constructed upon a foundation of reinforced concrete piles. Following on the virtual completion of the deep-water quay at Southampton the Southern Railway Company began early in the year the remodelling of the railway approaches to the quay and the reconstruction of Southampton West Station. The number of tracks between Southampton West and Millbrook Station will be doubled. Altogether about £250,000 is being expended on the railway works at Southampton West and on the new lines serving the dock area.

The Southampton Harbour Board decided early in the year to increase the scope of the dredging in the approaches to Southampton Docks, which is being done by the James Dredging Company, Ltd., as contractors to the Board. The additional dredging will be carried out in the neighbourhood of Fawley, and, on the completion of the present programme of works at a cost of some £275,000, there will be a minimum depth of 38ft. at the West Bramble, decreasing to a depth of 35ft. at the upper end of the navigable channel near the docks.

The Southern Railway Company is still engaged on the building of the closed dock at Dover, which is to accommodate the train ferry boats intended to ply between Dover and Dunkirk. The works are being carried out by Messrs. Nuttalls and Mowlems and are still far from being completed. A good deal of difficulty has been experienced in constructing the foundations for the dock and the entrance. The first of the three passenger train ferry steamers ordered for the new service, the "Twickenham Ferry," arrived at Dover from the Tyne in July. The second boat was launched at the end of July and the third in October. All three ferry boats are by Swan, Hunter and Wigham Richardson, Ltd. The ferry dock will be 415ft. long by 72ft. wide and it will be closed by double gates of the "Box" flap type. The closed dock is to be operated in the manner of a lock, the level of the water in it being raised or lowered as required so as to bring the rail tracks on the ferry boat approximately to the same level as those on the shore.

Bristol Channel and South Wales Ports.

Very little was done in the Bristol Channel ports during the year, except in connection with the re-equipment of the Great Western Railway Company's docks. Two new coal hoists were brought into use on the east side of the Roath Basin, Cardiff, in August. The building of these two appliances completes the remodelling of the coal shipping equipment at the Cardiff Docks, which was undertaken as the result of a grant obtained by the railway company under the Development Act, 1929. One of the two hoists is built on the quayside and the other on a jetty 50ft. out from the quay face. This arrangement permits of vessels being scarfed so that two large ships can be loaded simultaneously at the quay. Both hoists have a lift of 60ft. from the quay level and are fitted with anti-breakage appliances ; one is also equipped with a "Norfolk" digger for facilitating the shipment of washed duff.

Scotland.

The deepening of the river Clyde in the neighbourhood of the berth where the Cunard liner "Queen Mary" was laid down at Clydebank was completed by the Clyde Navigation Trustees in time for the launching of the vessel in September. This involved the removal of approximately 1,000,000 tons of spoil from the launching channel, which was cut diagonally across the river, and in the preparation of the berth for her reception after launching. The launching channel was deepened to 53ft. below M.H.W.S.T. The Clyde Trustees are also engaged on two widenings of the river Clyde below Clydebank, one of which has already been completed.

The Leith Dock Commissioners opened at the end of May a grain warehouse and grain-handling plant at the Imperial Dock, Leith, which take the place of a grain warehouse built in 1903 and destroyed by fire in January, 1930. The new building measures about 160ft. in length by 143ft. in width and has a total height of 150ft.; it is constructed throughout of reinforced concrete and its silos have a capacity of 20,000 tons of grain. Two pneumatic grain discharging plants of the travelling type have been provided on the quay of the Imperial Dock, each of which can discharge 180 tons of wheat per hour, delivering the grain to conveyor belts running over the quay to the grain warehouse. We printed a short illustrated description of this plant in our issue of June 1st last.

Other Ports of the United Kingdom.

The London and North-Eastern Railway Company completed during the year the Parkeston Quay extension, begun in 1931 to deal with the steadily increasing Continental trade at Harwich, which was formally opened on October 1st by Admiral of the Fleet Sir Reginald Tyrwhitt. The railway company has expended nearly £500,000 on the new works. The quay is of reinforced concrete, 1120ft. long, with a width of 146ft. In addition, a good deal of embanking and reclamation work has been done and long approach viaducts, also of reinforced concrete, have been built to provide railway access to the quay. The berths in front of the quay have been dredged to a depth of 20ft. at low water and behind the quay is a large passenger railway station and a two-storey transit shed, 900ft. long and 63ft. wide.

After negotiations which have occupied several years the Minister of Transport in October transferred to the Ramsgate Corporation the old harbour of that town which has been administered as a Government property for over 150 years, the Board of Trade having been the immediate predecessor of the Minister in control of it until 1919. We recorded a year ago the completion of the new lock which the Shoreham Harbour Trustees had built to give access to their wet dock, an undertaking of increasing importance, owing to the large electric power station of the Brighton Corporation being situated within its area. Last year the Trustees brought into use a small dry dock which has been made by a reconstruction of the old entrance lock.

The London Midland and Scottish Railway announced in December that further modernisation of the cross-Channel traffic accommodation and quay equipment at Fleetwood is to be undertaken immediately. Electric belt conveyors for bunkering trawlers are to be provided, and the whole of the existing hydraulic plant at the port is to be converted to electric power. Three of the coal conveyors will be installed in the Wyre Dock and three in the Fish Dock ; all of these will deal with 20-ton wagons. The scheme, which is estimated to cost £85,000, involves also the reconstruction of the timber piers at the north end of the dock, where Isle of Man traffic is dealt with, and the provision of additional siding accommodation.

At Preston the Ribble Navigation Authority has made some progress during the year with the seaward extension of the south training wall of the river Ribble by 1½ miles, for which Parliamentary sanction was obtained in 1931. An additional timber storage shed, 933ft. long by 80ft. wide, has been built at Preston Dock.

Inland Waterways of the United Kingdom.

The completion of one important section of the programme of reconstruction begun by the Grand Union Canal Company in 1932 was marked by the opening on October 30th by the Duke of Kent of the fifty-one new locks which have been built on the company's Warwickshire system. About £500,000 has been expended, mainly in connection with these locks, on the section of canal between Napton Junction and Knowle. The locks are designed to admit barges and motor-propelled craft up to 14ft. beam, carrying about 110 tons cargo, and take the place of fifty-two narrow locks. The replacement of flights of old locks, whose average lift is less than 7ft., by series of larger locks having practically the same average lift is explained by the strict limitation of available lockage water between Napton and Knowle. The water supply is insufficient to serve locks of 7ft. lift without recourse to some pumping, even under the most favourable conditions, and, had the number of the new locks been materially lessened with corresponding increase of lift, the pumping costs would have been raised to a prohibitive figure. The company is expending about £1,000,000 on its scheme of development and modernisation of which the new locks form a part. The remainder of the works, chiefly side-walling, deepening and straightening, is nearly finished.

(To be continued.)

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

HIGH-RUPTURING CAPACITY FUSES.

SIR,—The most interesting parts of Mr. Pooley's letter in your issue of December 21st are the last two paragraphs, in which it is suggested that the molten quartz becomes sufficiently conducting to carry an appreciable current, so shunting the arc stream from the central space left by the wire into the surrounding quartz, and that it is the cooling and resulting increase of resistance of this quartz tube that effects the final interruption of the circuit.

It is refreshing in these days when everything is explained by "de-ionisation" to find a simple conduction theory put forward.

The idea was in my mind as an alternative to the "thermo-chemical reaction" when I questioned the insulating value of the quartz, but it seemed too fantastic to venture on.

Fig. 1 seems to show that the current at the moment of transfer might be about 600 ampères, making the resistance about 0·7 ohm and the power dissipated somewhere about 150 kW.

The fuse is stated to contain twenty-one strands and if it is of normal construction one strand is of high resistance, designed to fuse after all the others have melted.

Mr. Pooley could, of course, give the exact dimensions of the parts of the tube which seemed to have been hot enough to carry current, but the inside diameter is not likely to be more than $\frac{1}{32}$in. and the length was given as $\frac{1}{16}$in.

It seemed too good to be true that this could carry sufficient current to be of use, and yet go on cooling when embedded in the rest of the quartz and surrounded by a stout steatite holder. Even if it only passed 1·5 kW, I cannot visualise it conducting and cooling.

Perhaps Mr. Pooley will tell us more about it and also show a graph for a 1500-ampère fuse on the same circuit.

The breaker operating time—inception of fault to contacts separate—seems to be about 0·0275 sec., and that is a remarkably good performance ; double that time would still be good.

Mr. Pooley shows that the self-induction of the circuit with breaker was 0·000134 henry and of the circuit with fuse 0·000092 henry, but the graph shows that the breaker circuit reached 20,000 ampères sooner than the fuse circuit ; also the slope of the fuse curve at B is about the same as the breaker curve at A, yet the fuse voltage is greater than the breaker voltage.

These things do not seem to tally somehow, but that is always the way ; it is a poor oscillogram that cannot be made to prove anything you like.

Mr. Pooley seems to show a good case for the "dust" fuse as compared with the rewireable type, but is the comparison quite fair ?

The two circuits seem to be the same because 14,300 ampères are reached in 0·0077 sec. and 20,000 in 0·0108 sec., but the maximum possible current "not less than 35,000 ampères" is 350 times full load for the 100-ampère fuse and only 70 times for the 500-ampère, while the peak currents reached are 143 and 40 times respectively ; the makers of the 100-ampère fuse probably do not claim any very wonderful breaking capacity.

For GEORGE ELLISON, LTD.,
J. ANDERSON, Chief Engineer.

Birmingham, December 27th.

SIXTY YEARS AGO.

THE year 1874 ended with two great disasters. On Christmas Eve at Hampton Gay, near Shipton, Oxfordshire, a Great Western train, running at about 35 miles an hour left the rails while on an embankment. Most of the carriages ran down the embankment and were smashed to pieces. Thirty-four persons were killed and sixty-nine injured. The weather at the time was very cold, and the train was double headed. These two facts are of prime significance in the explanation of the disaster. Other facts of importance are that the train was not fitted with continuous brakes and was equipped with an inefficient means of communication between the passengers and the train crew. The most important fact of all however is that the carriage next the engines was fitted with wheels consisting of a cast iron boss, wrought iron spokes and rim and an iron tire fastened to the rim by rivets, a design which the railway company had itself some years previously decided to discard. The cold weather, so it was held, weakened the wheel and caused the tire to fracture. A passenger riding in the leading coach endeavoured to communicate with the guard. The signal was not at once recognised, but when it became apparent that something was wrong the engine drivers immediately applied the brakes on the tenders and reversed their engines. The sudden deceleration derailed the train and the rest followed. From 1847 to 1874, eighty accidents, exclusive of the Shipton disaster, had been reported to the Board of Trade as having been caused by tire failures. In these accidents, all told, thirty-nine persons had lost their lives and 236 had suffered injury. The Shipton accident, by far worse than any that had occurred previously, led to great attention being paid to the fastening of tires to railway wheels and also to the more general question of the effect of low temperature on the strength of iron and steel. . . . The second disaster which marred the end of 1874 was the loss by burning at sea of the emigrant ship "Cospatrick." In that tragedy some 300 people perished. . . . These two calamities occupied a considerable proportion of our review of the year that had just closed which we published in our issue of January 1st, 1875. We urged upon our readers the necessity which they indicated of engineers continuing to develop means for promoting the safety of life on land and sea. So far as the railways were concerned the steps to be taken, we suggested, were not so much the development of new inventions and ideas as the adoption by the railway companies of improvements which were already available. We charged the railway companies with a general reluctance, on the score of expense, to apply certain recent inventions, such as continuous brakes and improved forms of carriage wheels, which would considerably enhance the safety of railway transport. As regarded safety at sea we commended the development and adoption of improved forms of lifeboat and life raft. . . . A glance ahead shows that the year then opening was to provide many more object lessons of a similar kind. At sea there were to be several serious incidents such as the loss of H.M.S. "Vanguard" and the stranding of the liner "Deutschland." On land there were to be disastrous boiler explosions at North Shields and Todmorden, colliery explosions in Wales and Yorkshire and a gun cotton explosion at Woolwich Arsenal. On the railways the most serious disaster was to be the Kildwick collision.

A PROPOSAL is to be put before the Canadian Government that an alteration should be made to international law to compel all sea-going vessels to carry wireless.

Electrical Engineering in 1934.

No. I.

THE improvement in the electrical industry from October 24th, 1933, to within two days of the same date of 1934 can be gauged from the fact that, according to Ministry of Labour statistics, the average decline in unemployment was 3·3 per cent. in all industries and 5·4 per cent. in general electrical engineering. Notwithstanding that from 1929 to 1933 there was a continuous decline in the export of electrical goods and machinery, representing a monetary fall of from £19,506,686 to £9,429,339, there was for the first ten months of 1934 an increase of about 19 per cent., or from £8,648,136 to £10,316,636. Switchgear, motors, and cables with insulation other than rubber, showed the greatest increases, which were £229,195, £206,134, and £228,496 respectively. During the same period imports of electrical goods increased by 28 per cent., or by £560,088, of which wireless apparatus was responsible for no less than £340,355. Imports of electrical machinery for the first ten months of 1934, valued at £302,662, showed an increase of £115,717 over the corresponding figure for 1933. Motors, switchgear, converters, and transformers (combined) and generators were responsible for the principal increases, which were £51,077, £35,595, £4046, and £16,925 respectively. Britain's electrical export trade is very specialised. Over 80 per cent. of it is associated with the Empire and Europe. Of Britain's exports of electrical goods and apparatus in 1933 (*sic*), the Empire took 59 per cent. and Europe 27 per cent., while the corresponding figures for electrical machinery were 62 and 25 per cent. Developments in those two regions are therefore of the greatest importance from the point of view of future foreign trade. Provided no further tariffs or quotas are imposed as trade revives in these two regions, it may reasonably be expected that exports may reach the 1929 level. In an industrial depression, it is the demand for "capital" goods, such as generators, converters, switchgear, motors, &c., that primarily suffers, while that for "consumption" goods, such as lamps, carbons, domestic appliances, &c., is, relatively speaking, unaffected. In times of depression there is a pronounced disinclination to undertake heavy capital expenditure and to install expensive plant which can only work at a profit when business is brisk. When replacements and extensions cannot be deferred any longer, the depression lifts, and the demand for "capital" goods then shows a greater increase than that for "consumption" goods. Thus it is reasonable to suppose that in the future the proportion of electrical machinery to that of apparatus will increase, although both items will rise in absolute terms.

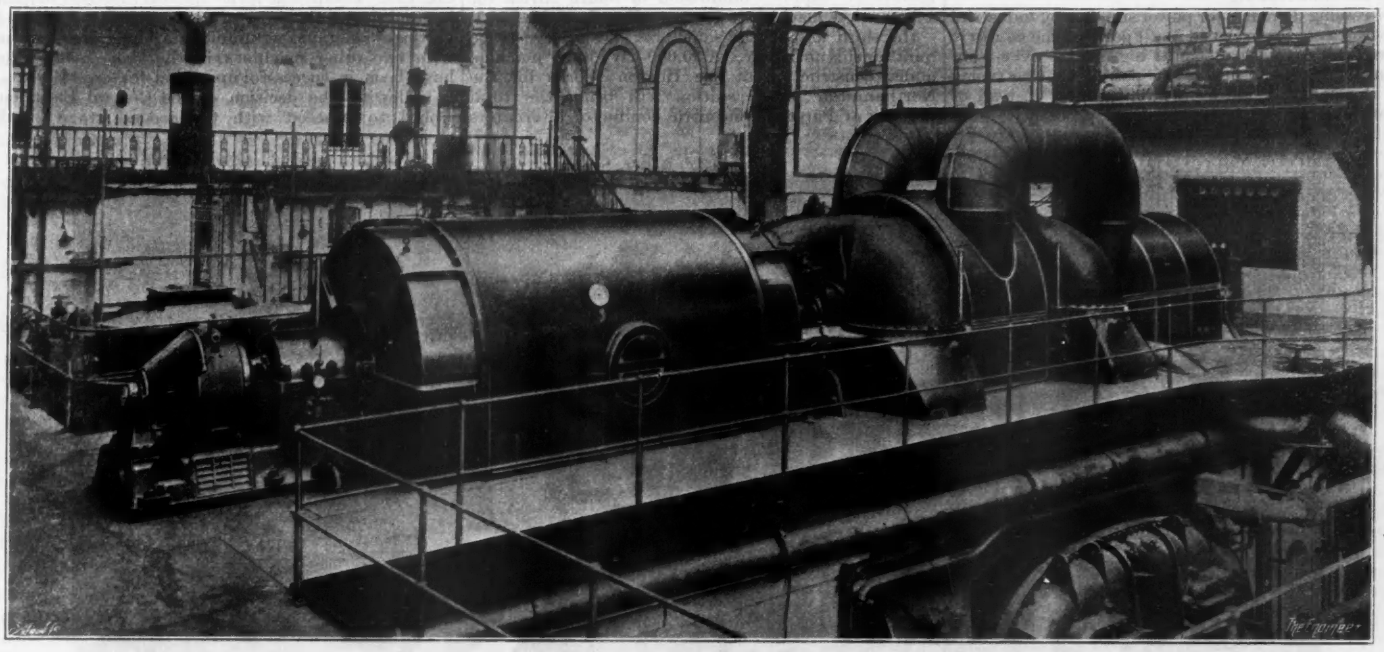


FIG. 1—30,000-KW TURBO-GENERATOR SET AT BRIGHTON

Generating Stations.

On the generation side of the industry, further progress was made in the direction of closing down old stations, whilst, as shown in the next section, covering the Central Electricity Board, sanction was given for extensions to selected stations. Good progress was made with the construction of the new Fulham power station and the Tir John North station, Swansea, which should be ready for operation about the middle of the present year. No fewer than twenty stations were closed down during 1934, and there were five at which no electricity was generated. Eight stations which had previously operated on a non-statutory basis became part of an authorised undertaking. The public authorities that closed down stations during the year were the Paisley Corporation, Dumfries Corporation, the Kirkcudbright County Council, the Colne Corporation, the Hoylake and West Kirby Urban District Council, the Liverpool Corporation (which shut down a dust destructor station), the Ammanford District Council, and the London and Home Counties Joint Electricity Authority (which shut down a station at Surbiton). The Kirkcudbright County Council put three stations out of action, viz., Dalbeattie, Dalry, and Gatehouse. Companies that shut down stations were the Grampian Electric Supply, Penrith Electric Supply, Settle and District, Shropshire, Worcestershire and Staffordshire Electric Power (which closed two stations), East Anglian Electric Supply, County of London (which closed the Dunmow station), West Cambrian, Chudleigh Electric Light and Power, and the Swanage Gas and Electricity Company, Ltd.

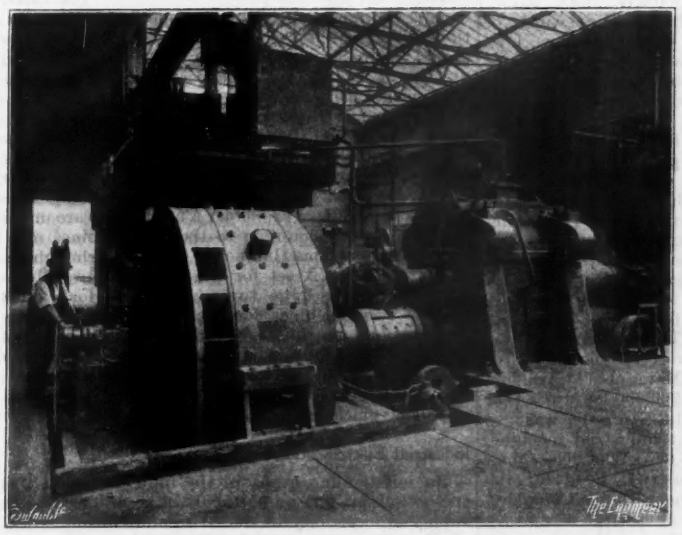


FIG. 2.—B.T.H. 3000 H.P. REVERSING MILL MOTOR

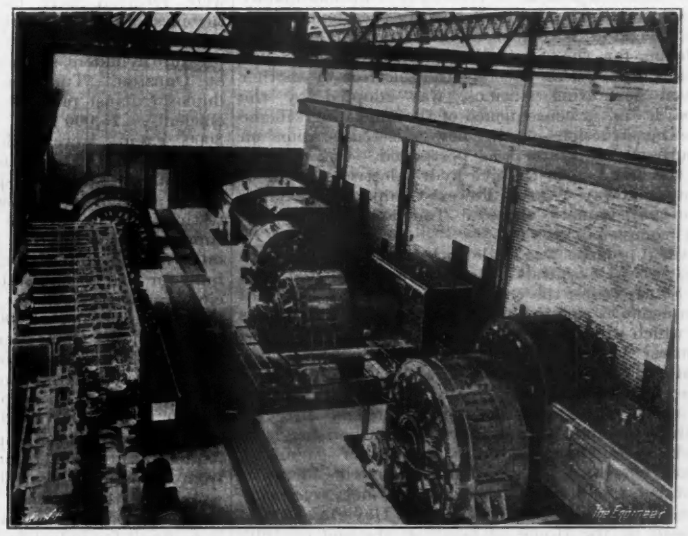


FIG. 3.—ELECTRICAL INSTALLATION FOR MERCHANT SKELP AND STRIP MILL

The Central Electricity Board.

In six of the regional areas covered by the grid scheme, the Central Electricity Board was engaged in general trading operations during 1934. At the beginning of 1933 trading was begun in Central Scotland and Mid-East England. On January 1st, 1934, the grid tariffs were introduced for South-East England and East England, now operated as one area, and North-West England and North Wales. Central England was brought under the grid tariff on April 1st. With the opening of the present year South-West England and South Wales and South Scotland came under the tariff. Thus, with the exception of the comparatively small area of North-East England, in which a considerable amount of frequency standardisation work is involved, the Board is operating, as contemplated by the 1926 Act, in all parts of the country for which schemes have been adopted.

Additional transmission lines and new grid points were established in various districts to meet the growing electrical demands. The Clacton ring, comprising about 40 miles of 33-kV transmission lines, was completed. Additional facilities for supplies to the Southern Railway were provided at Northfleet and Tunbridge Wells, and the extension of the electrified railway system will shortly necessitate other points of supply at Eastbourne and Hastings. The erection of a 33-kV line from Three Bridges to East Grinstead was begun. A grid point of supply, established at Beddington, Surrey, was put into service. At the beginning of April the new transmission line constructed by the Board between Northampton and Kettering to give supplies from the grid to the new iron and steel works of Stewarts and Lloyds at Corby was put into service, with the interesting result of enabling the Kettering Urban District Council to give an individual supply of electricity for industrial purposes in excess of the whole of the other demands upon the undertaking.

Increasing demands for power supplies by industrial concerns were experienced in all parts of the country. There is said to have been a big change over from steam and other sources of power to electricity, and the policy of taking a public supply instead of generating current on the premises proceeded at an accelerated rate. In 1933, the output of electricity by authorised undertakers was 10·7 per cent. over that for the preceding year, and during the first eleven months of 1934 there was a further increase of 4·9 per cent. over the corresponding period in 1933. To meet the anticipated demands of the country, the Central Electricity Board gave directions for extensions to selected stations, involving an aggregate expenditure of over 6 million pounds. Over a score of stations mainly in Central England are affected by these extensions. At the end of November, an alteration and extension scheme for the South-West England and South Wales area, giving effect to the selection of another seven generating stations, was adopted by the Board, and in consequence of the amending scheme the construction of the new selected station on Southampton Water was postponed. Construction of the first two of the five hydro-electric stations of the Galloway Water Power Company in South Scotland, namely, those at Tongland and Glenlee, was completed.

Good progress was made with frequency standardisation. In Cornwall the task was completed, and in South Wales the conversion of plant to standard frequency is now in hand. In the other two areas in which the change over is still incomplete, namely, Central England and North-East England, large additions were made to the capacity of plant converted to the national standard of 50 cycles. Powers to enable the Board to supply electricity direct to railway companies and provisions authorising it to make certain arrangements with authorised undertakers who are the owners of or who control generating stations which are not selected stations, were contained in a Bill introduced by the Government and passed by the House of Lords at the end of July. It was passed by the House of Commons in November, and received the Royal Assent before the adjournment for the Christmas holidays.

Generating Sets.

The 105,000-kW turbo-generator set ordered from the Metropolitan-Vickers Electrical Company, Ltd., in 1933, for the Battersea power station, still remains the largest British-made machine of its kind. Designed for a steam pressure of 575/600 lb. per square inch, and a total temperature of 850 deg. Fah., the turbine is of the three-cylinder impulse type, and the low-pressure cylinder illustrated in one of our Supplements has a double-flow exhaust with a Metropolitan-Vickers duplex exhaust incorporated in each flow. Other machines constructed by this firm during the year were of considerably lower output, but there was a substantial increase in the number of units and their aggregate capacity. Six machines of 30,000 kW capacity and over were ordered during 1934, the largest being a 53,000-kW set for Japan. An improved demand was experienced for the firm's self-contained sets, ranging in capacity from 200 to 5000 kW.

Sets manufactured by C. A. Parsons and Co., Ltd., ranged from turbines of 51,500 kW down to units of a few hundred kW for industrial purposes. The largest machines were destined for service in this country, but South Africa, Australia, Canada, India, and China all placed orders with the firm. Amongst the overseas orders was one from the Electricity Supply Commission of South Africa for a 20,000-kW machine to generate directly at 33–36 kV—the third unit of the same size and voltage to be built for this authority. A 30,000-kW, 36-kV machine under construction at the Heaton Works for the Northampton power station will bring the total number of Parsons concentric conductor alternators up to ten, with an aggregate capacity of 300,000 kVA. The Northampton alternator will be driven by a pure reaction turbine with two cylinders in tandem, and designed on similar lines to the machines of the same output and speed recently installed at Brighton—see Fig. 1—and Swansea, as shown in one of the Supplements.

The largest Parsons machines for which orders were received were the 51,500-kW, 1500 r.p.m. turbines for the City of Birmingham. These will be of the two-cylinder tandem type, with single-flow, low-pressure cylinders, similar to the 50,000-kW machines at Dunston. Turbines embodying the Parsons duplex exhaust principle and capable of developing efficiently 25,000 kW in a single cylinder at 3000 r.p.m. were ordered for both Hull and Southampton. For industrial purposes two Parsons turbo-alternators of a special character were completed and put into service. Both were designed for testing switchgear, the larger of the two being supplied to the Reyrolle testing station at Hebburn-on-Tyne. The alternator, the second of its kind to be built for this testing station, has a maximum short-circuit capacity of no less than 1,500,000 kVA at 22,000, 12,700, 11,000, or 6350 volts, according to the winding connections. The other machine was constructed for the laboratories of the N.V. tot Keuring von Electrotechnische Materiaten at Arnhem, Holland. It has an output of 900,000 kVA at either 11,000, 6350, 5500, or 3200 volts. An order was also received for another important industrial machine, namely, a turbo-generator of 15,000 kW at 3000 r.p.m. from Imperial Chemical Industries, Ltd., for the works of the Castner Kellner Alkali Company. It is not often that a machine of so large a capacity is required for industrial service, and the set is also notable for the advanced steam conditions under which it will operate, namely, a stop valve pressure of 600 lb. per square inch and a total temperature of 800 deg. Fah. Other industrial machines ranged in size from 5000 kW down to 500 kW, most of the sets being adapted for the extraction of low-pressure steam for heating or process work. Two mixed-pressure sets, each of about 3000 kW capacity, and to work with either high-pressure or exhaust steam and a pure back-pressure, 1500-kW unit, were also ordered.

Outstanding among the orders for generating plant received by the British Thomson-Houston Company was that for the 50,000-kW, 33-kV turbo-generator set for the Ironbridge power station of the West Midlands Joint Electricity Authority. The builders of this machine are also reconstructing a second 22,500-kVA set in the Stourport power station to operate at 50 cycles, 33 kV, a job that was awarded to the firm in consequence of the satisfactory performance of the first machine that was treated in this way about twelve months ago. Amongst other orders received for large B.T.H. machines was one for a 30,000-kW set for the Neepsend power station of the City of Sheffield Electricity Department, and another for a similarly rated unit for the North Wilford "B" power station of the Nottingham Corporation. A 20,000-kVA water wheel alternator, which will be a duplicate of two other machines installed in the Loch Rannoch station of the Grampian Power Company, was ordered for that station by Balfour, Beatty and Co., Ltd. For driving it the Engilsh Electric Company is supplying to the order of the same firm a 24,000 h.p. vertical reaction hydraulic turbine corresponding with two other machines of the same make which have been in successful operation for several years.

Following the decision of the Central Electricity Board to proceed with the second stage of the Galloway hydro-electricity scheme, an order was awarded to the English Electric Company for the water turbines and generators for the Kendoon, Earlstoun and Carsfad power stations and also for the switchgear, cables, heating, and lighting installations for the two latter stations. An order was received from the Sheffield Corporation for a 30,000-kW set. Space will not permit us to consider all the company's oil engine contracts. Among the most important was one for the installation of four 750 h.p. engines and generators—shown in one of our Supplements—in the Midland Regional Station of the British Broadcasting Corporation at Droitwich, the engines being of the "L" type.

The General Electric Company, of Witton, Birmingham, reports that there was a good demand for industrial turbo-alternator sets, particularly those designed for supplying process steam. Many slow and medium-speed alternators were built for export to various parts. Two 62,500-kVA alternators are under construction for coupling to the new turbines mentioned for the Hams Hall power station, Birmingham, and a 20,000-kVA set for the Johannesburg Municipality. Other large turbo-alternators for export include two machines for the Palestine Electricity Corporation, one of 15,000 kVA and the other of 7500 kVA capacity. G.E.C. turbo-alternator sets for outputs up to 1500 kVA at 3000 r.p.m. are now manufactured in more compact form than hitherto without impairing efficiency and reliability.

Industrial Electrification.

An outstanding event in the industrial field was the switching on, on October 19th, of an outside supply of electricity to the Atlas and Norfolk works of Thomas Firth and John Brown, Ltd., originally supplied by two private generating stations, with a total capacity of 20,000 kW. The scheme gives to the Sheffield Electricity Undertaking an additional load of at least 80 million units per annum, which, needless to say, is no small asset. While orders for new electrical industrial equipment were not numerous, some of them were far from insignificant. A direct-current reversing rolling mill motor (Fig. 2), with a peak rating of 3000 h.p. at 50 r.p.m., was supplied by the B.T.H. Company to Thomas Firth and John Brown, Ltd., for driving a 35in. reversing

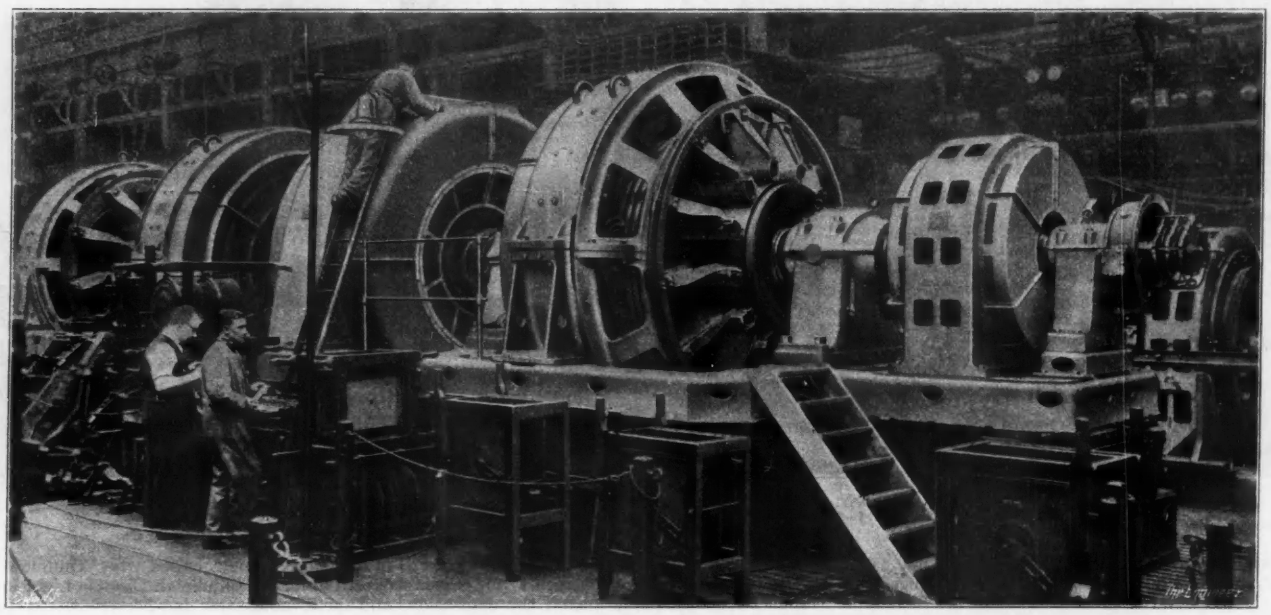


FIG. 4—METROPOLITAN-VICKERS SYNCHRONOUS MOTOR GENERATOR SET FOR ROLLING MILL DRIVE

mill for rolling Staybright steel billets to plates. The motor is supplied from a motor generator fly-wheel set, consisting of an 800-kW, 480-volt D.C. generator and a 9-ton fly-wheel, both directly coupled to a 1000 h.p., 1000-volt, 750-r.p.m. induction motor.

Another large rolling mill installation put into service during the year was a 10in. and 12in. continuous merchant skelp and strip mill at the Newcastle works of the Broken Hill Proprietary Company, New South Wales. The electrical equipment (Fig. 3) supplied by the B.T.H. Company for this machine includes nine D.C. mill motors with a total of 6900 h.p., a main motor generator set, with an auto-transformer and starting switch, mill motor, and generator control rheostats, auxiliary exciters, complete remote control equipment, and metering and protective equipment. Orders were placed with the same company for eight Ward-Leonard winder equipments, and several geared induction motor winders were supplied, including a repeat order for one of 900 h.p. for Rose Deep, Ltd. An A.C. sectional drive was completed by the B.T.H. Company for driving an exceptionally large newsprint machine in the new extension to the Kemsley Mill of Edward Lloyd, Ltd. The total ratings of the A.C. commutator motors employed in the drive amount to over 2000 h.p. The maximum paper speed of the driven machine is 1400ft. per minute. A small sectional drive was also completed for driving a machine in New Zealand. A large rubber factory in Durban was equipped by the same company with motor generator sets, motors, control gear, switchboards, and transformers, the mills being driven through clutch brakes by H.T. synchronous induction motors. Large variable-speed calenders are driven by D.C. motors with booster variable voltage control, while smaller calenders and extruders are driven by D.C. motors with shunt field control. A group of five B.T.H. motor converters, each rated at 3000-kW, 12,500 ampères, 210–260 volts, when supplied with 50-cycle current and running at 273 r.p.m., was supplied to Imperial Chemical Industries, Ltd.

The conversion of the Ryhope Colliery to electric driving was one of the most important industrial jobs carried out by the General Electric Company. It included the dismantling of three beam engines installed some eighty years ago, and their replacement by three large G.E.C. Fraser and Chalmers electric winding engines. The equipment supplied included over 100 motors, with a total capacity of 8000 h.p., together with appropriate motor control gear, main and auxiliary distribution switchgear, transformers, cables, &c. The electrification of a semi-continuous bar and strip mill was carried out by the G.E.C. at the Courtybella Works, Newport, of the Whitehead Iron and Steel Company. Several G.E.C. 2500 h.p. motors, with phase advancers were built for driving pulp grinders in a large paper mill. Plant is being manufactured by the same company for the Cyprus Copper Mines. Four G.E.C. rolling mill motors, the largest of 1500 h.p., form part of the electrification of a hot strip rolling mill in Sheffield. Two textile mills overseas are being electrified by the company on an extensive scale, one in China and the other in India. Other industries in which the company found electrification to be making headway were paper-making, food preparation industries, and various sections of the chemical industry.

The Metropolitan-Vickers Electrical Company also electrified factories of various kinds. Many motors were made for use on farms and for driving lifts and hoists, some of them having to meet somewhat unusual requirements in the way of the control of lifting and lowering speeds. The company re-equipped a number of textile mills, which were provided in some cases with synchronous motors to improve the power factor. The synchronous motor generator set shown in Fig. 4 was supplied by the company for the new rolling mill drive at the Corby Mill of Stewarts and Lloyds, Ltd. It comprises a 125-volt exciter for the 7000 h.p., three-phase, 50-cycle, 11,000-volt, 500 r.p.m. motor, a 2000-kW compensated shunt generator, two 1800–3000-kW compensated shunt generators, and a slip-ring induction motor for starting the set. The English Electric Company also experienced improvement in the demand for industrial electrical equipment and was associated in several instances with the giving of bulk supplies to large manufacturers, including Thomas Firth and John Brown, Ltd., to whom it supplied two 20,000-kW transformers for transmission to the Atlas Works.

Rectifiers.

Perhaps the most noteworthy achievement in the field of rectifier development was the construction by the B.T.H. Company of two 20,000-volt 600-kW equipments for the Droitwich station of the B.B.C. —see Supplement—the first rectifiers to be built for such a high pressure in this country. To provide rapid suppression of the short-circuit current in the event of flash arcs occurring in the transmitting valves they are equipped with grid control arrangements. Voltage regulation down to zero is obtained by an induction regulator or alternatively by grid control. Two 2000-kW 630-volt B.T.H. rectifiers were installed in a new sub-station of the London Passenger Transport Board, and three of the same capacity will shortly be put into service in the Leicester-square sub-station of that authority. Other rectifiers were built by this firm for three-wire power and lighting service, including two 500-kW 250–500-volt equipments for use in a totally automatic sub-station of the North-Eastern Electric Supply Company, in which they will replace 40-cycle converters. For supplying current for arc lights a 500-kW equipment was installed in the Twickenham film studio. Orders in hand include rectifiers for tramway service and six rated at 2500 kW at 3300 volts for operation in railway sub-stations. Extensive investigations were carried out by the company during the past twelve months on methods of exciting rectifier grids, and apparatus has been developed which is claimed to ensure accurate firing, dead-beat control without running contacts. Several rectifiers are in course of construction at the works of the General Electric Company, Witton, Birmingham, including four for the Borough of Poplar, four for the North-Eastern Electric Supply Company, two for the Sheffield Corporation, and one for the Copenhagen Municipality.

(To be continued.)

Water Supply & Sanitary Engineering in 1934

No. I.

WATER supply engineers throughout the country must have welcomed wholeheartedly the December rains. If the weather can be induced to remain decidedly wet for some months longer anxiety as to the position during the summer of 1935 will no longer be necessary. At this time last year we wrote that, following upon an exceptionally dry year, a plentiful winter rainfall was required to fill depleted reservoirs and revive failing springs if the position of water supply undertakings was not to become precarious in several districts during the following summer, and those remarks hold with greatly augmented strength at the present time. During 1934 many rural and even a number of urban districts were affected by shortage of water supplies, and although remedial emergency measures have been taken, another exceptionally dry winter will give great cause for anxiety. Nor are sewage engineers unaffected by the state of affairs, for a sufficiency of water is necessary for the adequate functioning of their plant.

One of the most important events of the year was the action of the British Association and the Institution of Civil Engineers in sending a deputation to meet the Prime Minister with the object of impressing upon the Government the need for a systematic survey of the water resources of the country. In a memorandum submitted to the Minister, it was suggested that the task might fitly be undertaken through the agency of the Department of Scientific and Industrial Research.

The carrying out of public works during the year 1934 was affected to some extent by the depression, but a number of works which had been temporarily postponed were put into execution, and with the gradual return of prosperity more and more work was undertaken or planned as the year progressed. In what follows we give some notes of the work now being carried out in various parts of the country.

London.

By the courtesy of the Metropolitan Water Board we are enabled to give the following details of work done in the London area during the year.

Supply from Lee Valley.—The construction of the conduits referred to in THE ENGINEER of January 5th, 1934, is now complete. The work has been executed by Sir Robert McAlpine and Sons (London), Ltd.

Primary Filtration Plant, Green Lanes Works.—Good progress has been made during the year on the primary filtration plant, to which reference was made in THE ENGINEER of January 5th, 1934. The work should be completed before the end of next summer. The contractors are W. and C. French, Ltd. Six sets of electrically driven vertical-spindle centrifugal pumps are being installed, four for pumping primary filtered water on to the slow sand beds and two for filter-bed washing. The contractors for the machinery are Gwynnes Pumps, Ltd.

Fortis Green Pumping Station.—The extension of the building for which William Moss and Sons, Ltd., are the contractors is now complete. The erection of the machinery supplied by W. H. Allen, Sons and Co., Ltd., is proceeding. It consists of four oil engines driving centrifugal pumps, each capable of pumping in series 2 million gallons per twenty-four hours against a head of 260ft., or in parallel 4 million gallons per twenty-four hours against a head of 130ft.

Rye Common.—The machinery at this well station is being replaced by electrically driven centrifugal pumps supplied with current purchased from the North Metropolitan Electric Power Supply Company. Two vertical-spindle centrifugal pumps are being installed, one capable of pumping 3 million gallons and the other 2 million gallons per twenty-four hours from a depth of 180ft. into the New River. In addition there are two surface units, each capable of pumping 0·25 million gallons per twenty-four hours into supply against a head of 350ft. The contractors for the machinery are Sulzer Brothers, Ltd.

Sundridge.—The temporary machinery and buildings at this station are being replaced by permanent plant. The machinery will consist of two oil engines driving centrifugal pumps, each having a capacity of 1 million gallons per twenty-four hours against a head of 590ft. In addition, each unit will drive a 25-kW electric generator. Two bore-hole pumps are being installed, one driven by an electric motor the other by a water turbine. The contractors for the machinery are Belliss and Morcom, Ltd., with pumps by the Harland Engineering Company, Ltd., and for the buildings Grace and Marsh, Ltd.

Green Street Green.—An additional bore-hole is being sunk at Green Street Green and oil-engine-driven machinery is being installed in an extension to the existing engine-house. The new machinery will have an output of 1 million gallons per twenty-four hours.

Summer Supply, 1934.—In consequence of the drought the construction of certain works was advanced in order to enable additional Thames-derived water to be transferred to the north-eastern portion of the Board's area, the following plant being installed during the early part of 1934.

Battersea.—Two oil engines driving centrifugal pumps have been installed in an existing building for repumping to New River Head or Campden Hill. Each unit is capable of delivering 10 million gallons per twenty-four hours against 120ft. to the New River Head, or 7·5 million gallons per twenty-four hours against 160ft. head to Campden Hill. One of the engines was supplied by Mirrlees Bickerton and Day, Ltd., and is a three-cylinder oil engine; the other, a six-cylinder airless injection engine, was supplied by Ruston and Hornsby, Ltd. The contractors for the centrifugal pumps were Worthington-Simpson, Ltd. The plant was completed and set to work within nine weeks of the Board's decision to carry out the scheme.

Kew Bridge.—Four oil engines and centrifugal pumps were supplied by W. H. Allen, Sons and Co., Ltd., and erected in a temporary engine-house. By means of this plant the delivery of the 36in. main from Kempton Park to Finsbury Park Reservoir was considerably augmented. The four engines are identical and are each capable of pumping 4½ million gallons per twenty-four hours against a head of 180ft. These were also completed within nine weeks.

Campden Hill.—Two oil engines driving centrifugal pumps, each having a capacity of 5 million gallons per twenty-four hours, have been installed in an existing building for repumping into the Soho area. The contractors for the engines were Petters, Ltd., and the centrifugal pumps were supplied by the Harland Engineering Company, Ltd.

Brixton.—A seventh oil engine driving centrifugal pumps was installed at this station, which was fully described in an article in THE ENGINEER of April 20th, 1934. The new unit is identical with the six engines previously supplied by W. H. Allen, Sons and Co., Ltd.

Pumping From Gravel Beds.—Five small oil engines driving centrifugal pumps were installed for abstracting water from gravel beds in the Thames Valley. The engines were manufactured by the National Gas and Oil Engine Company, Ltd., Crossley Brothers, Ltd., and Petters, Ltd., the pumps being supplied by Mather and Platt, Ltd. A system for collecting water from the gravel known as the Ranney Water Mine was installed near Sunbury.

Merton Abbey Well.—This well, which had been sealed over for a number of years, was brought into use. Temporary plant was erected in twelve days and an output of about 1 million gallons per twenty-four hours obtained.

Portable Plant.—The Board has purchased three portable generating sets of 120 b.h.p. each—one vertical-spindle, electrically driven bore-hole pump, capable of lifting 2 million gallons per twenty-four hours from a depth of 145ft., and two sets of electrically driven horizontal centrifugal pumps, capable of pumping in all 4 million gallons per twenty-four hours against a head of 150ft., or 1 million gallons per twenty-four hours against a head of 600ft. The whole of this plant is mounted on pneumatic-tired trailers. The generating sets were supplied by W. H. Allen, Sons and Co., Ltd., the vertical-spindle pump by the Harland Engineering Company, Ltd., and the two sets of horizontal centrifugal pumps by Gwynnes Pumps, Ltd. It is intended to use this plant to deal with minor emergencies, and to facilitate the replacement of plant at well stations.

A considerable amount of work in connection with flood relief and sewage disposal was also carried out in the London area, as the following notes supplied to us by Mr. J. Peirson Frank, Chief Engineer to the London County Council, will show.

Main Drainage Pumping Stations and Outfalls.—The reorganisation of the machinery of the purification plant and the installation of oil-driven generators at the Southern Outfall Works, Crossness, has been completed. At the Western Pumping Station, Grosvenor-road, works intended for the relief of flooding have been commenced. These works comprise the removal of the existing beam engines and pumps and the installation of electrically driven and Diesel engine-driven centrifugal pumps of a total capacity of 850 tons per minute. A contract has been accepted for the extension of the purification plant by the activated sludge process at the Northern Outfall Works, Becton.

Flood Relief Works.—Two important flood relief works have recently been commenced. One is to benefit the boroughs of Lambeth and Camberwell and consists of about 2½ miles of sewer varying in size between 4ft. 6in. and 6ft. 6in. internal diameter. The other one, from Uxbridge-road to Hammersmith-road, serves the same purpose for Hammersmith, this sewer being 5ft. 6in. and 6ft. 6in. diameter (internal), 1 mile in length. The construction of the Plumstead branch of the Southern High Level Sewer No. 2 for the relief of flooding and the diversion of the drainage of the higher parts of Plumstead into the high-level sewers has been completed. Other works brought into use in this connection have been two branches of the Southern Low Level Sewer No. 2 in Battersea, the enlargement of the Wandle sewer in Garratt-lane, Wandsworth, and the extension of the Lewisham branch sewer from Southend-lane to Sydenham-road, and a branch of the Fleet storm relief sewer in Caledonian-road. Work in connection with the River Lee improvement scheme undertaken by the West Ham and River Lee Joint Committee, and necessitated by the widening of the waterway, is still in progress and entails the extension by two additional spans of the bridge carrying the four 9ft. by 9ft. northern outfall sewers over the waterworks river. In addition to all the foregoing, a number of important repair and maintenance works have, as usual, been carried out during the year.

West Middlesex Sewerage Scheme.

The construction programme for the West Middlesex main drainage scheme has been proceeding very rapidly, and the rate of work carried out has reached a value of about £150,000 per month. Of the 76 miles of sewers constituting the sewerage system, 58 miles have been completed of various diameters up to 12ft. 9in. The consulting engineers, Messrs. J. D. and D. M. Watson, anticipate no difficulty in completing all sewers by next October, which marks the termination of the four-year period allowed for this undertaking. In the case of the purification works at Mogden, which are being constructed to serve a population of 1,250,000, excellent progress has been made and a large proportion of the excavation and concreting has been completed. The sludge disposal works at Perry Oaks are also being proceeded with at an accelerating rate.

Provincial Work.

By the courtesy of Messrs. J. D. and D. M. Watson, of Westminster, we are able to publish the following details of several schemes now being carried out.

The new works undertaken by the Urban District Council of Darlaston, which form extensions of the existing plant, comprise two circular biological filters, 110ft. diameter; two humus tanks, each 35ft. long by 30ft. wide; and certain additions to the ejector system for dealing with supernatant water and sludge. The general contractors are Hussey, Egan and Pickmere, Ltd., Birmingham; Hartley Sons and Co. are supplying the distributors; and Hughes and Lancaster's ejectors have been selected. A separate contract for the supply of filter medium has been awarded to Tarslag, Ltd. The estimated cost of the scheme is £12,000. Work has been commenced upon the Exhall sewerage scheme for the Bedworth Urban District Council, and 15,000 lineal yards of sewers will be constructed in stoneware, concrete, and steel in sizes up to 21in. diameter. The contractors are P. D. Hayes and Son, of Stockport. The sewers, which will be capable of serving an ultimate population of 27,000 persons in Exhall and Bedworth, will discharge into the Sowe Valley sewer now being constructed by the Coventry Corporation. The cost of the work will be about £25,000. The Tamworth sewage disposal works, now in course of construction, provide for a total expenditure of £7200. The contract for the construction of storm water tanks, pipe lines and alterations at the pumping station was awarded to the firm of Cameron and Pooley, Ltd., Birmingham, which is now proceeding with the work. New pumping plant, comprising five centrifugal pumps driven by electric motors with automatic controls, is being installed by Tangyes Ltd., Birmingham.

Extensions and modifications to the sewage disposal works of Louth, Lincolnshire, were completed in July. The work was to the value of £14,353 12s. 2d. and comprised principally the construction of three circular biological filters, 110ft. diameter, two shallow horizontal flow humus tanks, a new pumping station, improved sludge lagoons and alterations to the existing tanks. A point of interest in the design of these works is that the three large filters and the humus tanks, situated in marshy ground, are entirely supported upon " Vibro " R.C. piles. The general contractors were Hadsphaltic Construction Company, Ltd., of Crutched Friars, London, E.C.3.

At Oxford Waterworks the construction of the intake works pumping station, sedimentation tanks, filters, and rising main, together with some 5 miles of 27in., 20in., and 18in. diameter pipe lines for distribution of the water, was completed during 1934, and the new works were formally inaugurated by Lord Desborough in June last. The engineers for these works, all of which were carried out by contract, were Messrs. Binnie, Deacon and Gourley.

Steady progress has been made with the Langthwaite Reservoir at Lancaster, and the work has so far advanced that it was possible to start filling the reservoir in September last. The admission of water is under control and the level to which the reservoir is to be filled is at present restricted to 10ft. below top water, as the pitching on the main embankment is not yet completed. James Mansergh and Sons, of Westminster, are the consulting engineers to this scheme.

Birmingham.

Beyond continuing the work of laying extensions to the third main on the Elan aqueduct, and the laying of three large trunk mains within the parliamentary area of distribution, the water department of the City of Birmingham carried out no works of considerable importance. A considerable amount of work for the relief of floods and the disposal of sewage was, however, carried out.

Following the completion of the improvement of the river Tame in 1933, work was commenced on the improvement of the Rea, and the first contract, which comprises a little under 2½ miles of the river, terminating at Lawley-street goods station, is now nearing completion. The work includes the widening of the river from 30ft. to 40ft., and an average deepening of 4ft. Throughout this length the banks are supported by heavy retaining walls, and the bed of the river has been paved with Staffordshire blue wire-cut bricks on a concrete foundation. The improved river has a capacity of 350,000 cubic feet per minute. The contractors for this work are Sir Robert McAlpine and Sons (Midlands), Ltd., of Liverpool. Birmingham, Meriden and Solihull joint sewerage works, which were commenced towards the end of 1931, have now been completed and brought into operation, the sewage being treated at a new disposal works constructed by the Birmingham, Tame and Rea District Drainage Board at Coleshill. The scheme provides for the drainage of some 15,000 acres in which development is proceeding very rapidly, both in the city area and in the portion lying within the districts of Meriden and Solihull. The contractors for this work were Bolton and Lakin, Ltd., of Birmingham.

These works were officially opened on October 24th. The first unit has been designed to deal with a daily dry-weather flow of 2,000,000 gallons. The plant is characterised by the fact that use is made of the gas evolved in the digestion of the sludge to furnish all the power required; that the secondary tanks and aeration tanks have been designed to balance the unequal dry-weather flow and ensure a uniform rate of discharge of the treated effluent; and that provision has been made to flocculate the colloidal matter entering the secondary sedimentation tanks by interposing between the primary and secondary sedimentation tanks a special pre-aeration tank supplied with the excess activated sludge from the aeration tank. Eventually there are to be five units, but at present only one is in operation. Since a second unit will be required at an early date, such buildings as the power-house and compressor-house have been built sufficiently large to accommodate two units. The approximate cost of the works has been £144,000. Four small sewage works are superseded by this scheme. A number of sewer reconstruction and extension schemes are now being built.

Glasgow.

The water department of the Corporation of Glasgow has replaced the steam plant in the Springburn pumping station by three electrically driven centrifugal pumps. Each pump delivers 800 gallons per minute, is of the two-stage, horizontal split casing type, and is driven by a 52 h.p., A.C. motor at 960 r.p.m. About 1¼ miles of 24in. cast iron main has been laid besides smaller pipes.

(To be continued.)

BRITISH STANDARDS INSTITUTION.

All British Standard Specifications can be obtained from the Publications Department of the Institution at 28, Victoria-street, London, S.W.1. The price of each specification is 2s. 2d. post free, unless otherwise stated.

POINT-OPERATING MACHINES FOR RAILWAYS.

No. 581—1934. This specification deals with the performance tests for electrically driven point-operating machines. In such apparatus speed of operation is all important, but it must be accompanied by the ability to exert sufficient thrust to overcome the resistance due to ice, snow, or other obstruction. The times of operation and the thrusts laid down in the specification were arrived at as the result of an extensive series of tests carried out by and on behalf of the B.S.I. Committee with the co-operation of the four main line railway companies and the L.P.T.B. In addition to the performance tests, the specification deals with the general features of construction, with a view to securing a standard range of machines which will be satisfactory for all normal service requirement or British and overseas railways.

ASBESTOS PIPES AND FITTINGS.

No. 582—1934. This specification covers the dimensions and workmanship of asbestos cement soil, waste and soil, and waste ventilating pipes and fittings. It forms one of a series of four British Standards for asbestos cement pipes, and includes a comprehensive range of pipe fittings for use with soil-drainage systems. Whilst it is restricted, for the time being, to dimensions and workmanship, investigations are at present being made with a view to including performance tests in a future edition. Standardisation of the spigot and socket joint to secure interchangeability between pipes and their various connections is provided for.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

ROBERT HUDSON, Ltd., announces that it has changed its address from 38A Bond-street, Leeds, to Raletrux House, Meadow-lane, Leeds.

COCHRANES (MIDDLESBRO') FOUNDRY, Ltd., has sublicenced the Stanton Ironworks Company, Ltd., near Nottingham, to use the Mairy Patent Process in connection with the centrifugal casting of pipes.

BIRMINGHAM ELECTRIC FURNACES, Ltd., announces that an agreement has been completed between it and the Detroit Electric Furnace Company of U.S.A. for the sole manufacturing rights in the Detroit rocking electric arc furnace for the British Isles, Dominions, and certain other countries.

MR. G. H. TWELVETREES, owing to ill-health, has resigned his position as manager of the Manchester Divisional Office of J. and E. Hall, Ltd., but is retained by the firm as consultant, and will continue his interest in the company's activities. Mr. Twelvetrees will continue to live at Altrincham.

MR. G. RIDLEY WATSON, B.Sc., A.M.I.N.A., has been appointed London manager of Henry Robb, Ltd., of Leith. Mr. Watson was for six years London manager of the shipyard department of Sir W. G. Armstrong Whitworth and Co., Ltd. Mr. Watson's office will be at 78, Gracechurch-street, London.

HENRY SIMON, Ltd., Cheadle Heath, Stockport, announce the appointment of four additional directors. They are Mr. I. Hey, head of the conveying and silo department; Mr. J. F. Lockwood, chief flour milling expert; Mr. J. W. Muirhead, commercial manager of the flour milling section, and Mr. C. H. Marsh, accountant.

MR. R. P. SLOAN, who was appointed manager of the Newcastle-upon-Tyne Electric Supply Company, Ltd. (now the North-Eastern Electric Supply Company, Ltd.) thirty-one years ago, has retired from the managing directorship of the company. Mr. Sloan, though ceasing to act as managing director, will continue as chairman of the company, a position which he has held since 1921.

CONTRACTS AND ORDERS.

The Editor is always happy to print short announcements of contracts and orders in this column provided they are sent to him in time to have news value and that they are likely to interest readers.

JOHN M. HENDERSON AND CO., Ltd., King's Works, Aberdeen, have received an order for a 6-ton level luffing crane for Leith Harbour.

INTERNATIONAL COMBUSTION, Ltd., announces that it has received the order covering the dust and grit-disposal plant for the extensions to Hams Hall power station of the Birmingham Corporation Electricity Department.

THE ENGLISH ELECTRIC COMPANY, has secured a contract from the London Midland and Scottish Railway for ten oil-electric shunting locomotives, each of 350 h.p. This order is the result of successful tests carried out during the past seven months with a demonstration engine of the same type, facilities for whose trial on an extended scale were given by the L.M.S. The locomotives will be constructed in conjunction with Hawthorn Leslie and Co., Ltd., of Newcastle-on-Tyne, who will supply the mechanical structure, the English Electric Company supplying the oil engines, generators, driving motors, and control equipments.

CALENDARS, DIARIES, &c.

ASHWELL AND NESBIT, Ltd., Barkby-lane, Leicester.—Wall calendar.

BRITISH INSULATED CABLES, Ltd., Prescot, Lancs.—Wall calendar.

BRITISH THOMSON-HOUSTON COMPANY, Ltd., Rugby.—Greeting card.

D. P. BATTERY COMPANY, Ltd., Bakewell, Derbyshire.—Wall calendar.

THE COMMISSIONER AND EXECUTIVE OFFICERS, NEW SOUTH WALES RAILWAYS.—Greeting card.

J. DINE AND CO., 60, Mount-street, Nechells, Birmingham, 7.—Wall calendar.

ENGLISH STEEL CORPORATION, Ltd., Vickers Works, Sheffield.—Greeting card.

FLOWERDEW AND CO., Ltd., 227/228, Strand, W.C.2.—Wall calendar.

FORD MOTOR COMPANY, Ltd., Dagenham, Essex.—Greeting card.

GREYCAINE, Ltd., 10, Great Queen-street, Kingsway, W.C.2, and Watford.—Wall calendar.

GREENWOOD AND BATLEY, Ltd., Albion Works, Leeds.—Wall calendar.

R. AND W. HAWTHORN, LESLIE AND CO., Ltd., Forth Bank Works, Newcastle-upon-Tyne.—Wall calendar.

HIGH SPEED STEEL ALLOYS, Ltd., Ditton-road, Widnes.—Greeting card.

IMPERIAL CHEMICAL INDUSTRIES, Ltd., Millbank, S.W.1.—Diary.

" LOCOMOTIVE, RAILWAY CARRIAGE, AND WAGON REVIEW," Amen Corner, Paternoster-row, E.C.4.—Greeting card, coloured reproduction of the " Cock o' the North."

MATHER AND PLATT, Ltd., Park Works, Manchester.—Engagement pad.

Markets, Notes and News.

The prices quoted herein relate to bulk quantities. Unless otherwise specified home trade quotations are delivered f.o.t. Export quotations are f.o.b. steamer. A comprehensive list of the prices of materials mentioned below will be found on the next page.

The Continental Steel Position.

The iron and steel markets on the Continent, as in this country, have been practically idle since the Christmas break, and it is not anticipated that business will become normal until about the second week in January. The German works appear to be better off as regards orders than any of the other Continental industries, and are reported to be refusing new business in steel bars. The Belgian steel makers had a smaller reserve of orders on their books at the commencement of 1935 than at the beginning of last year, and are facing the future with some anxiety. Disagreements have been reported between the different sections of the trade in Belgium, and lately there has been an agitation by the stockholders of that country against direct sales by the steel works. As a result of these protests it is understood that a check will be placed upon this class of trading by the works. Although more Continental steel was sold in Great Britain in 1934 than in 1933, the Continental manufacturers are by no means satisfied with the amount of business done in our market, the more so as their trade lately has suffered from the recent extension of the British makers' rebate schemes. The possibility that further ground may be lost by the imposition of higher duties in the coming year is causing concern to other industries than the Belgian, which would be chiefly affected. The Germans and the French are both aware that it would result in intensified competition in the markets which still remain open to Continental steel. Lately there have been reports that heavy tonnages of iron and steel materials of various descriptions will be placed by Russia and Japan early in the New Year, but it is difficult to find any substantial foundation for these rumours. Hopes are entertained, however, that the International Raw Steel Cartel Commission, which is to visit Japan and probably China, may do something towards restoring the Continental steel trade with these countries. Lately there has been some improvement in the French home demand for iron and steel, which has been poor for some time. It is reported that some of the steel works in Lorraine are preparing to relight additional furnaces.

The Pig Iron Market.

Little business has been transacted in pig iron this week. Deliveries in some cases were resumed immediately after the holidays, but these had been arranged for beforehand and were for the most part to supply urgent needs. As the production of pig iron continued throughout the holidays, stocks have accumulated at the makers' yards to some extent. On the North-East Coast the holidays were rather shorter than for some years past, and in one or two cases consuming establishments also worked right through the holidays. This, of course, is an indication of a general improvement in business in this district. The Cleveland blast-furnacemen have entered the New Year with comfortably filled order books. In fact, in some instances consumers have arranged for supplies over the whole of 1935. In the Midlands the resumption of work after the holidays was irregular, but a few foundries recommenced operations on the Thursday after Christmas. The producers in this district are well off as regards orders, and many consumers have already covered their requirements for the first quarter of the year. On the other hand, there is no difficulty in obtaining prompt supplies for those who prefer to buy as the need arises. In Scotland, deliveries have been suspended on account of the New Year holidays, and the makers' stocks have been added to. The demand up till the end of the year was on a good scale, and it is not expected that there will be any reduction in the number of furnaces in blast when work is resumed. At the close of the year thirteen furnaces were in operation, six on hematite, three on basic, and four on foundry. In Lancashire business in pig iron is not expected to become normal until the middle of January. The year closed with a tendency for consumption in this district to improve. The demand for hematite iron during the last quarter of 1934 was satisfactory, and heavy deliveries were made to the Midlands and to a lesser extent to South Wales. It is claimed that the North-East Coast producers have sufficient orders on their books to account for the first quarter's output.

The Midlands and South Wales.

Work was generally resumed this week at the Midland finishing works, although operations in some departments were interrupted by repairs to plant and by stocktaking. The demand for joists, sections, and structural steel generally developed a strong tone after the holidays, and from the satisfactory position as regards orders in which many of the constructional engineers finished the year, it seems likely that busy conditions will rule during the first quarter. According to reports some good contracts will probably reach the structural engineers during January. The plate mills are not so well provided with work, and business in boiler plates in particular has been on quiet lines for some weeks. Lately, rather more transactions in ship and tank plates have taken place, but there is still considerable room for improvement in business in this department. The sheet works are well employed on the whole, and have started the New Year with anticipations that during the next few weeks business is likely to improve. Irregular conditions exist at the re-rolling works, and the demand for steel bars and strip has not recovered the ground lost in the autumn. Quotations are unchanged, the associated works quoting £8 12s. for small bars, less a rebate of 2s. 6d., whilst the strip works quote £9 7s. Firms outside the Association quote about 20s. less, whilst foreign material is available at £7 1s. 6d. for bars, and £7 10s. for strip, d/d and including duty. Continental joists can be bought at £7 2s. to £7 5s., and angles at £7 3s. 6d., duty paid. There has been some recovery in the demand for colliery steel, which is usually quiet at this time of the year. Prices remain unaltered at £7 15s. for light and £8 15s. for heavy arches, with bridge rails at £7 10s. The markets in South Wales were practically idle this week as a result of the holiday conditions. Business in tin-plates has been dull for some weeks, but lately has shown signs of improving. The steel works are moderately busy, and appear to have sufficient orders on their books to keep them well employed over the first quarter of the year. Quieter conditions have developed in the sheet and tin-plate bar departments, but this is chiefly the result of the holiday slackness.

Current Business.

The London, Midland and Scottish Railway has placed an order with Armstrong, Whitworth and Co., Ltd., of Scotswood-on-Tyne, for ten Diesel-electric shunting locomotives. The contract is valued at about £100,000. The same company is undertaking the reconstruction in steel and concrete of the Burleigh Viaduct between Derby and Manchester, and it is estimated that this work will require 600 tons of steel. The Daimler Company, Ltd., of Coventry, has received an order for 135 fluid fly-wheel omnibus chassis. The possibility of re-opening the Ebbw Vale Steel Works is under discussion by Mr. P. M. Stewart, one of the Government Commissioners for the depressed areas, and Sir John W. Benyon, chairman and managing director of the Ebbw Vale Company. An order for new plant, including helical geared grinding machines, single and four-spindle automatics, combination and centre lathes, and grinding, milling and drilling machines, has been placed by Leyland Motors, Ltd., of Leyland. The total value of the orders is estimated at £50,000. It is reported from Athens that the Greek Government has placed a contract with Vickers, Ltd., of Barrow, for two destroyers. Plans have been approved for the erection of a new steel bridge of three spans to be built at Millheugh, Larkhall, for the Larkhall County Road Board, at a cost of £4200. The Department of Overseas Trade announces that the following contracts are open for tender:—Indian Stores Department: tubular steel poles, 65,000 bearing plates for the East Indian Railway (New Delhi, January 22nd); Johannesburg City Council: galvanised pipe fittings screwed to British standard thread to stand a test pressure of 300 lb. per square inch; four 18in. sluice valves with 3in. by-pass and twelve 9in. sluice valves without by-pass (South Africa, January 12th); brass stop cocks and bib cocks (Johannesburg, January 12th); Egypt, Ministry of Education: machine tools and equipment (Cairo, February 5th); Argentine State Railways Administration: 13,561 m. of seamless steel tubes for locomotive boilers and 241 m. of flexible steel piping for steam (Buenos Aires, January 18th); twelve electric overhead travelling cranes, capacity from 1 to 76 metric tons (Buenos Aires, March 15th); Siam, Royal State Railways: 500 fish bolt spanners with 35·5 mm. jaw (Bangkok, January 18th); New Zealand, Posts and Telegraphs Department: 5100 galvanised earth rods (Wellington, February 26th); 60 miles of insulated and braided P.J.B. bronze wire; 12,000 swan-neck galvanised steel bolts (Wellington, February 4th).

Ferro-alloys.

Practically no business has been transacted in this market since the holidays, and it could hardly be said that the position is so good as in January, 1934. Consumers of most ferro-alloys seem inclined to limit their purchases to immediate requirements, and the forward contracts which have been entered into have not, as a rule, been for large tonnages. The producers of ferro-silicon, however, report that they are fairly well booked for the next three or four months, and that in a number of cases contracts which expired at the end of the year have been renewed for a further period. The market for ferro-chrome was fairly active until just before the holidays, and when business was resumed inquiry was on a good scale, although it remains to be seen how much of this will materialise into business. Quotations in this market have a tendency to fluctuate, and this causes buyers to adopt a cautious attitude. The demand for ferro-manganese, which has been a feature of the alloys market for the greater part of last year, showed no signs of falling off after the holidays. The demand is principally on home account, although there is a steady, but not very active, export business passing. Quotations are firm at £11 5s. d/d to £10 15s., less allowances to members of the rebate scheme. Conditions in the market for ferro-molybdenum have remained unaltered for some months, and so far as can be seen there is no likelihood of any immediate change either in conditions or prices. Transactions in ferro-tungsten have been limited, since the impression prevails amongst consumers that prices are likely to decline in the New Year. As a result, buying has been confined to small prompt parcels. Business in ferro-vanadium has been on a comparatively good scale for the past few weeks. Satisfactory conditions rule in the market for nickel, and quotations have been retained at the longstanding figure of £200 to £205 per ton, home and export. Recently it was announced that the Treasury, on the recommendation of the Import Duties Advisory Committee, had added to the Free List, as from December 17th, nickel, unwrought in rondels, but not including alloys of nickel. The Committee considered that nickel imported in the form of rondels should be exempted from duty equally with the other forms of unwrought nickel which were already on the Free List.

Copper and Tin.

The market for electrolytic copper has been quiet since work was resumed after the holidays. Consumers at this time of the year are usually indifferent to the market, as they are engaged in stocktaking and repairs to plant, and this is reflected in dull conditions. Rumours have been current regarding the intentions of the producers, but no definite news as to the meeting which it is expected will be held in January has been available. In the meantime the market has been swayed by contradictory reports, but there has not been sufficient business passing for changes of sentiment greatly to affect prices. In the middle of the present week some inquiry was received from the Continent, but few transactions were reported with British consumers, although the Admiralty placed a small order. More confidence is apparent than was the case at the beginning of 1934. For one thing, important electrical schemes are being undertaken in various parts of the world and the consumption of copper by other industries seems to be improving. Business in the standard copper market has been on a limited scale. There is a large bull account in this market, speculators having been encouraged by the low price of the metal and the prospects of the producers reaching an agreement to operate upon a considerable scale. There has also been a certain amount of investment buying, principally by Continental interests, which have taken the copper off the market. . . . No developments of interest have occurred in the tin position, and it is not likely that business will become normal until towards the end of the month. Speculators fight shy of tin in these days, although before the control there was usually a large account open. On the whole, the consumption of the metal last year was satisfactory, but there was a rather disturbing fall towards the latter months. The statistics for December proved quite as good as was anticipated. The American deliveries worked out to the high figure of 4530 tons, whilst the total deliveries to all countries was 8333 tons. The decline in the visible supply has been 1770 tons.

Lead and Spelter.

Following the holidays this market returned to the colourless condition in which it closed the year. As in other departments of industry, consumers showed little interest in the metal. For the most part they have covered their requirements for January and are engaged in stocktaking operations. Complaints regarding the effect of the import duties on foreign lead and spelter, to which reference has been made frequently in these reports, have at length had some effect. It has been announced that the Board of Trade has asked the Import Duties Advisory Committee to inquire into the working of the import duties on foreign lead and zinc. The Metal Exchange takes the view that the duties are largely responsible for depressing the prices of these metals to their present levels, and the Board of Trade, in its announcement, states that the Empire producers have represented to the Government that the London Metal Exchange quoted price for foreign metal is not the real price. They have expressed the opinion that "the spirit of the Ottawa agreement would be properly observed if the world price were taken to be the price of foreign metal on the London Metal Exchange with the addition of the import duty. The lead consumers have objected to this proposal on the grounds that it would be harmful to the manufacturing trades using lead as material." The Board of Trade also refers to complaints from consumers of lead and zinc as to "the difficulty of obtaining sure supplies from the Empire and as to prices." Upon the results of this inquiry which the Import Duties Advisory Committee has undertaken depend the future of both these markets and for the time being interest is concentrated upon this development. Naturally, in these circumstances the markets have been idle.

Non-ferrous Metal Average Quotations.

The non-ferrous metal average prices for the last month of the year were disappointing. Copper was the only metal which showed an improvement upon November, the average quotations for tin, lead, and spelter, the other metals dealt in on the Exchange, registering small declines. The average quotation for cash copper in December showed an advance of 12s. 1d., whilst for three months copper the increase was 13s. 4d. For electrolytic copper the average improved to the extent of 16s., and for wire bars the increase was 14s. 8d. On the other hand, the average for best selected copper was 17s. higher than the November figure. Prices in the tin market have been "pegged" for some time, so that the movements have not been wide; but the average for cash tin for December showed a decline of 8s. 3d., and for three months tin of 4s. 5d. Lead quotations have been steady over a long period, and the average for the current month's shipment showed a fall of only 2s. 4d., and for shipment the third following month 1s. 11d., the decline in the mean average being 2s. 2d. Spelter average quotations also compared unfavourably with the previous month, the average for the current month shipment being 5s. 5d. down and for shipment the third following month 2s. 6d., whilst the average mean quotation was 5s. 4d. lower than in November. The following are the official average quotations for December:

STANDARD COPPER	Cash	£27	17	6 1/8
	3 Months	£28	5	4 1/4
	Settlement	£27	17	10 1/4
ELECTROLYTIC COPPER		£31	6	4 1/2
ELECTROLYTIC WIRE BARS		£31	11	0 1/2
BEST SELECTED COPPER		£31	0	7 1/2
STANDARD TIN	Cash	£228	5	1 1/2
	3 Months	£228	11	7 1/2
	Settlement	£228	0	5
LEAD	For shipment the current month	£10	6	3 1/2
	For shipment the third following month	£10	10	0
	Mean	£10	8	1 1/2
	Settlement	£10	6	5 1/2
SPELTER	For shipment the current month	£11	14	7 1/2
	For shipment the third following month	£12	0	3 1/2
	Mean	£11	17	5 3/4
	Settlement	£11	14	8 1/2

Current Prices for Metals and Fuels.

Makers' official home trade prices, per ton, delivered buyers' stations. Sections, joists and plates are subject to a rebate to home users purchasing only from associated British Steelmakers: joists, 22s. 6d.: plates and sections, 15s. Export orders of 250 tons and over may be subject to special quotations.

PIG IRON.

	Home. (*D/d Teesside Area*)	Export.
N.E. COAST—	£ s. d.	£ s. d.
Hematite Mixed Nos.	3 8 6	3 2 0
No. 1	3 9 0	3 2 6
Cleveland— (*D/d Teesside Area*)		
No. 1	3 10 0	3 4 0
No. 3 G.M.B.	3 7 6	3 1 6
No. 4 Forge	3 6 6	3 0 6
Basic (*Less 5/– rebate*)	3 7 6	—
MIDLANDS—		
Staffs.— (*Delivered to Black Country Station*)		
North Staffs. Foundry	3 11 0	
„ „ Forge	3 6 6	
Basic (*Less 5/– rebate*)	3 12 6	
Northampton—		
Foundry No. 3	3 7 6	
Forge	3 2 6	
Derbyshire—		
No. 3 Foundry	3 11 0	
Forge	3 6 0	
SCOTLAND—		
Hematite, f.o.t. furnaces	3 11 0	
No. 1 Foundry, ditto	3 12 6	
No. 3 Foundry, ditto	3 10 0	
Basic, d/d (*Less 5/– rebate*)	3 7 6	—
N.W. COAST—		
Hematite Mixed Nos.	3 12 6 d/d Glasgow 4 0 6 „ Sheffield 4 5 6 „ Birmingham	

MANUFACTURED IRON.

	Home.	Export.
LANCS.—	£ s. d.	£ s. d.
Crown Bars	9 12 6	—
Best Bars	10 2 6	—
S. YORKS.—		
Crown Bars	9 12 6	—
Best Bars	10 2 6	—
MIDLANDS—		
Crown Bars	9 15 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	7 5 0 to 7 15 0	—
SCOTLAND—		
Crown Bars	9 12 6	9 5 0
Best	10 2 6	9 15 0
N.E. COAST—		
Common Bars	9 12 6	8 15 0
Best Bars	10 2 6	9 15 0
Double Best Bars	10 12 6	10 0 0

STEEL.

	Home.	Export.
LONDON AND THE SOUTH—	£ s. d.	£ s. d.
Angles	8 10 0	7 7 6
Tees	9 10 0	8 7 6
Joists	8 17 6	7 7 6
Channels	8 15 0	7 12 6
Rounds, 3in. and up	9 10 0	8 7 6
„ under 3in.	8 14 6	—
Flats, 5in. and under	8 14 6	7 2 6
Plates, ¾in. (basis)	9 0 0	7 15 0
„ 7/16in.	9 5 0	8 0 0
„ ½in.	9 10 0	8 5 0
„ 3/16in.	9 15 0	8 10 0
„ ¼in.	9 10 0	8 5 0
NORTH-EAST COAST—	£ s. d.	£ s. d.
Angles	8 7 6	7 7 6
Tees	9 7 6	8 7 6
Joists	8 15 0	7 7 6
Channels	8 12 6	7 12 6
Rounds, 3in. and up	9 7 6	8 7 6
„ under 3in.	8 12 0	7 10 0
Plates, ¾in.	8 15 0	7 15 0
„ 7/16in.	9 0 0	8 0 0
„ ½in.	9 5 0	8 5 0
„ 3/16in.	9 10 0	8 10 0
„ ¼in.	9 5 0	8 5 0
Boiler Plates, ¾in.	9 5 0	8 5 0
MIDLANDS, AND LEEDS AND DISTRICT—	£ s. d.	£ s. d.
Angles	8 7 6	7 7 6
Tees	9 7 6	8 7 6
Joists	8 15 0	7 7 6
Channels	8 12 6	7 12 6
Rounds, 3in. and up	9 7 6	8 7 6
„ under 3in.	8 12 0	7 10 0
Flats, 5in. and under	8 12 0	8 17 6
Plates, ¾in. (basis)	8 17 6	7 15 0
„ 7/16in.	9 2 6	8 0 0
„ ½in.	9 7 6	8 5 0
„ 9/16in.	9 12 6	8 10 0
„ ⅝in.	9 5 0	8 5 0
Boiler Plates, ¾in.	9 7 6	7 15 0 to 8 5 0

STEEL (*continued*).

	Home.	Export.
GLASGOW AND DISTRICT—	£ s. d.	£ s. d.
Angles	8 7 6	7 7 6
Tees	9 7 6	8 7 6
Joists	8 15 0	7 7 6
Channels	8 12 6	7 12 6
Rounds, 3in. and up	9 7 6	8 7 6
„ under 3in.	8 12 0	7 10 0
Flats, 5in. and under	8 12 0	8 17 6
Plates, ¾in. (basis)	8 15 0	7 15 0
„ 7/16in.	9 0 0	8 0 0
„ ½in.	9 5 0	8 5 0
„ 9/16in.	9 10 0	8 10 0
„ ⅝in.	9 5 0	8 5 0
Boiler Plates	9 5 0	8 5 0
SOUTH WALES AREA—	£ s. d.	£ s. d.
Angles	8 7 6	7 7 6
Tees	9 7 6	8 7 6
Joists	8 15 0	7 7 0
Channels	8 12 6	7 12 6
Rounds, 3in. and up	9 7 6	8 7 6
„ under 3in.	8 12 0	7 10 0
Flats, 5in. and under	8 12 0	8 17 6
Plates, ¾in. (basis)	8 17 6	7 15 0
„ 7/16in.	9 2 6	8 0 0
„ ½in.	9 7 6	8 5 0
„ 9/16in.	9 12 6	8 10 0
„ ⅝in.	9 10 0	8 5 0

IRELAND—	Belfast. £ s. d.	Rest of Ireland. £ s. d.
Angles	8 12 6	8 15 0
Tees	9 12 6	9 15 0
Joists	9 0 0	9 2 6
Channels	8 17 6	9 0 0
Rounds, 3in. and up	9 12 6	9 15 0
„ under 3in.	9 2 0	9 4 6
Plates, ¾in. (basis)	9 0 0	9 2 6
„ 7/16in.	9 5 0	9 7 6
„ ½in.	9 10 0	9 12 6
„ 9/16in.	9 15 0	9 17 6
„ ⅝in.	9 12 6	9 15 0

OTHER STEEL MATERIALS.

	Home.	Export.
Sheets.	£ s. d.	£ s. d.
10-G. to 13-G., f.o.r.	9 0 0	8 15 0
14-G. to 20-G., d/d	10 5 0	9 0 0
21-G. to 24-G., d/d	10 10 0	9 5 0
25-G. to 27-G., d/d	11 2 6	9 17 6

The above home trade prices are for 4-ton lots and over; 2-ton to 4-ton lots, 10s. per ton extra; and under 2-ton lots, 30s. per ton extra.

Galvanised Corrugated Sheets, Basis 24-G.

Home.	£ s. d.
4-ton lots and up	13 0 0
2-ton to 4-ton lots	13 7 6
Under 2 tons	15 0 0

Export: £16 12s. 6d., c.i.f. duty paid India.
„ £11 5s. 0d., f.o.b. other markets.
„ Scandinavian Markets free.

Tin-plates.
20 by 14 basis, f.o.b. Bristol Channel Ports, 18/2.
Tin-plate Bars, d/d South Wales Works, £5 7s. 6d.

Billets.	£ s. d.
Basic (0·33% to 0·41% C.)	6 12 6
„ Medium (0·42% to 0·60% C.)	7 2 6
„ Hard (0·61% to 0·85% C.)	7 12 6
„ „ (0·86% to 0·99% C.)	8 2 6
„ „ (1% C. and up)	8 12 6
Soft (up to 0·25% C.), 500 tons and up	5 10 0
100 tons	5 15 0
Rails, Heavy, 500-ton lots, f.o.t.	8 10 0
„ Light, f.o.t.	7 10 0

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	3/3 per lb.	
Ferro Tungsten	3/– per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	7/–
„ „ 6 p.c. to 8 p.c.	£21 12 6	7/–
„ „ 8 p.c. to 10 p.c.	£21 12 6	7/–
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£34 0 0	11/–
„ „ „ 1 p.c. carbon	£38 15 0	12/–
„ „ „ 0·70 p.c. carbon	£42 0 0	12/6
„ „ „ carbon free	10d. per lb.	
Metallic Chromium	2/5 per lb.	
Ferro Manganese (loose)	£10 5 0 home	
„ Silicon, 45 p.c. to 50 p.c.	£13 0 0 scale 5/– p.u.	
„ „ 75 p.c.	£18 7 6 scale 6/– p.u.	
„ Vanadium	12/8 per lb.	
„ Molybdenum	5/3 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£200 to £205	
Ferro Cobalt	5/3d. per lb.	

NON-FERROUS METALS.

Official Prices, January 2nd.

COPPER—	
Cash	£28 6 3 to £28 8 9
Three months	£28 15 0 to £28 16 3
Electrolytic	£31 10 0 to £32 0 0
Best Selected Ingots, d/d Birmingham	£31 15 0
Sheets, Hot Rolled	£58 0 0
	Home. Export.
Tubes, Solid Drawn (basis)	9¼d. 9¼d.
„ Brazed (basis)	9¼d. 9¼d.
BRASS—	
Ingots, 70/30, d/d Birmingham	£27 0 0 to £29 0 0
	Home. Export.
Tubes, Solid Drawn, 2/1 Alloy	8¾d. 8¾d.
„ Brazed	10¾d. 10¾d.
TIN—	
Cash	£228 7 6 to £228 10 0
Three months	£228 5 0 to £228 7 6
LEAD	£10 5 0 to £10 11 3
SPELTER	£12 0 0 to £12 6 3
Aluminium Ingots (British)	£100

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
f.o.b. Grangemouth)—Navigation Unscreened	13/– to 13/6
„ Glasgow—Ell	16/– to 16/6
„ „ Splint	17/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	14/– to 14/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Prime Steam	14/–
Unscreened Navigation	12/6 to 13/–
LOTHIANS—	
(f.o.b. Leith)—Hartley Prime	13/6
Secondary Steam	13/–

ENGLAND.

YORKSHIRE, MANCHESTER—	
B.S.Y. Hard Steams	18/6 to 21/6
Furnace Coke	15/– to 17/6
NORTHUMBERLAND, NEWCASTLE—	
Blyth Best	14/6 to 15/–
„ Second	13/3
„ Best Small	10/6 to 11/–
Unscreened	12/6 to 13/6
DURHAM—	
Best Gas	14/8
Foundry Coke	18/6 to 22/6

SHEFFIELD—	Inland.
Best Hand-picked Branch	24/– to 26/–
South Yorkshire Best	21/– to 23/–
South Yorkshire Seconds	17/6 to 19/–
Rough Slacks	8/– to 9/–
Nutty Slacks	7/– to 8/6

SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Admiralty Large	19/6
Seconds	19/– to 19/4½
Best Dry Large	18/9 to 19/3
Ordinaries	18/3 to 18/6
Best Bunker Smalls	13/6 to 14/–
Cargo Smalls	11/6 to 12/6
Dry Nuts	22/– to 26/–
Foundry Coke	24/– to 37/6
Furnace Coke	19/– to 21/6
Patent Fuel	21/–
SWANSEA—	
Anthracite Coals:	
Best Large	37/6 to 47/6
Machine-made Cobbles	33/6 to 46/6
Nuts	34/– to 45/–
Beans	26/6 to 34/–
Peas	18/6 to 22/–
Rubbly Culm	8/6 to 11/–
Steam Coals:	
Large	17/– to 28/–

FUEL OIL.

Inland consumption; contracts in bulk.
Exclusive of Government tax of 1d. per gallon.

Ex Ocean Installation.	Per Gallon.
Furnace Oil (0·950 gravity)	3½d.
Diesel Oil	4d.

Manchester prices ½d. per gallon extra.

French Engineering Notes.

(From our own Correspondent in Paris.)

The Motor Car Industry.

THE Citroën failure is regarded as having prepared the way for a better stability of the motor car industry as a whole. It has revealed the danger of mass production methods when carried beyond the bounds of commercial prudence. The policy of widening markets by a costly organisation involving heavy charges that can only be met by a continued increase of sales places no limit on production, and when the shadow of the slump was falling a new Citroën factory was built to double the output of cars, while in foreign cities money was spent on constructions that denoted a peculiarly optimistic view of business development. The home market is not capable of absorbing more than 150,000 to 200,000 cars a year, and the total capacity of production of all makers is twice that number, so that with the partial closing of foreign markets the time appeared to have arrived when the industry would have benefited more from retrenchment than expansion. Since the slump began prices have fallen 25 per cent. as the result of mass production competition, and as costs have not been proportionately reduced the situation is unsatisfactory. The reorganisation of the Citroën business, if the necessary financial assistance is forthcoming, will bring it into harmony with the interests of the motor car industry generally.

Shipbuilding.

Towards the end of 1933 the Government issued a circular to the effect that five shipyards at Grand-Quévilly, Graville, Blainville, Chantenay, and Port-de-Bouc would be deprived of State financial credits and State orders for ships of more than 1000 tons, and that the big shipbuilding companies should amalgamate in their respective centres at Saint-Nazaire, Nantes, and Bordeaux. The idea of amalgamation was accepted when, at the instigation of the Government, the Consortium National des Constructions Navales was formed with a view to rationalising the shipbuilding industry. But the suppression of small shipyards which would necessarily follow upon the withdrawal of State credits and State orders was strongly resisted by their owners. The Blainville yard, near Caen, has already been closed down. Chambers of Commerce and other bodies protested against the suppression of small yards as being disastrous to local interests, and the legality of the Government's circular was contested and referred to the Conseil d'Etat for judicial decision. The Government has now given way and withdrawn the circular pending consideration of a plan which is being prepared by the Consortium National des Constructions Navales for a complete reorganisation of the shipbuilding industry.

Railway Signals.

The experts' report upon the reliability of the automatic signalling system at the time of the Lagny disaster two years ago was not made public, but an immediate result of that inquiry was the preparation of a scheme of improved electrical signalling equipment on the French railways which is now being carried through actively. The trial of the driver of the express which crashed into the train with such a heavy loss of life turned last week entirely upon the reliability of the signal. The driver and fireman both declared that the signal was at clear, and the recording instrument in the cab would have supported that testimony if it were not for an apparently justifiable belief that the apparatus failed to give an accurate record. There was nothing to disprove that the signal was at clear when the locomotive passed it, except evidence of the company's engineers who stated that the signals were in perfect working order. On the other hand, railwaymen were equally unanimous in affirming that there had been irregularities in the working of the signals, and an engineer with railway experience in the United States and in Europe declared that he had often observed delays in the operation of automatic electric signals abroad. After so much conflicting evidence judgment was deferred.

The "Atlantique."

The Paris Court of Appeal has given judgment against the insurance underwriters, who are now definitely responsible for the payment of the full amount of 170,000,000f. to the Compagnie Sud-Atlantique for the total loss of the "Atlantique," which was burnt out in the Channel three years ago. Before the appeal was made the money had been paid to the owners in order to prevent a further accumulation of interest, which is said to have reached about 15,000,000f. The judgment of the Court of Appeal rejects all the arguments put forward by the insurance companies. It refuses to admit that there was proof of defective electrical installations on board, or that the liner could have been reconditioned in a British shipyard for less than 100 million francs in a manner to offer sufficient guarantee of safety.

Hot Water Distribution.

When the Paris Metropolitan Railway Company began to avail itself of supplies from electricity companies it closed down its own power stations, and one on the Quai de la Rapée was acquired by a company with a view to the distribution of hot water for central heating in that neighbourhood. This enterprise followed upon the successful operation of similar schemes in the United States and in Hamburg, Copenhagen, and other European towns. After several years' working within the Bercy district, with mains having a total length of about 1¼ miles, the Paris company has just completed the laying down of another feeder main, 3000 yards long, which extends beyond the Hotel de Ville. Additional boilers are being installed. The Paris system differs from similar installations abroad in the provision of a main for the return of condensed water and in the hot water being distributed at a lower pressure, varying from 2 to 6 atmospheres.

British Patent Specifications.

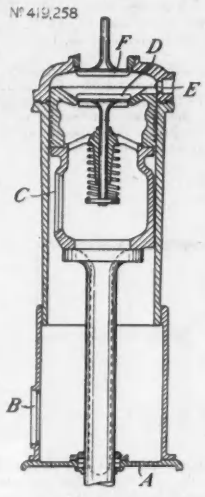
When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.



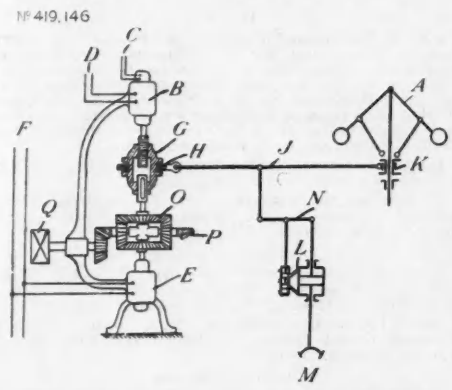
419,258. May 1st, 1934.—INDUCTION VALVES, J. Miller, of Harland and Wolff, Ltd., Queen's Island, Belfast, Ireland; and F. E. Rebbeck.

In this engine the piston is hollow and the space between it and the crank case is sealed off by the diaphragm A. Into this space air is sucked on the upstroke through the non-return valve B. It is compressed on the downstroke and passes to the interior of the piston through the valve C. At the end of the upward stroke the valve D is opened by its own inertia and the air is transferred to the cylinder head. It is carburetted at E and exploded by the compression temperature. Finally the positively operated valve F exhausts the burnt charge.—*November 8th*, 1934.

TURBINE MACHINERY.

419,146. May 2nd, 1933.—MEANS FOR REGULATING ELECTRIC POWER TRANSMISSION SYSTEMS, *International General Electric Company, Inc., of 120, Broadway, New York, U.S.A.*

This invention applies to mechanism for regulating prime movers for the drive of alternating-current generators in electric power transmission systems. A indicates a centrifugal speed governor on the prime mover, and B a synchronised motor which is controlled at a constant speed by a standard clock through the conductors C, and which is driven, for example, by a direct-current source through the conductors D. The network clock comprises a synchronous motor E connected to the network F of the machine to be regulated and rotating with the frequency of this system. G is the main differential of the regulator, the movable central sleeve of which is rotatably seated in a ring H pivoted to the free end of the control lever J of the prime mover control. The sleeve is connected non-rotatably with the shaft of the motor E, but is able to slide axially thereon. The

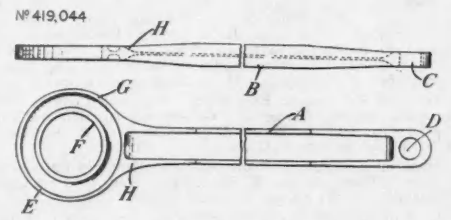


connection of the sleeve with the motor B is effected through a spindle thread. If the speed of the two motors E and B is the same, then the sleeve of the differential G is merely taken round without displacement from the central position. If a difference occurs between the two speeds, then the sleeve is displaced either upwards or downwards, whereby the control lever J is swung either upwards or downwards about the pivot point at the sleeve K of the speed governor A. Thereby the control slide of the valve gear L is moved and the main admission valve M is either opened or closed. N is the return rod provided in the known manner for the control valve. Besides the differential gear G, an additional differential gear O is provided, and the planet wheel spindle carries a toothed rim P, which can be rotated through the gear Q by hand or in dependence upon output. Thereby the sleeve of the differential gear G can be raised or lowered as required, and thus the admission to the prime mover can be changed.—*November 2nd*, 1934.

LOCOMOTIVES.

419,044. June 13th, 1934.—CONNECTING-RODS, The Timken Roller Bearing Company, of Corner of Denbar-avenue and Nineteenth-street, Canton, Ohio, U.S.A.

This invention relates principally to main or connecting-

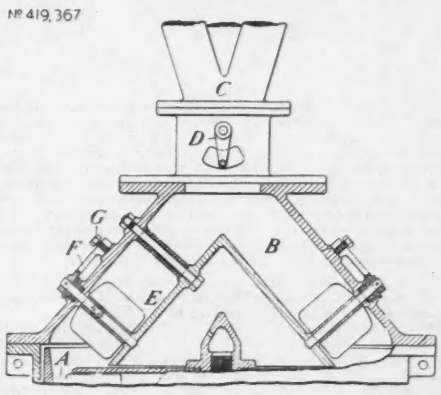


rods for locomotives. It has for its principal objects to reduce the weight of the rod and to increase its strength and rigidity and the resistance of its enlarged crank pin receiving end to deformation. The rod comprises a shank or body portion A, which is substantially I-shape in cross section. The side flanges B of the shank or main body portion A of the rod are widest along the middle portion of the rod and taper in width towards the ends thereof. The crosshead pin end C of the rod is of conventional shape, and has the usual crosshead pin receiving opening D. The other or crank pin end E of the rod is enlarged and has a crank pin opening large enough to accommodate a roller bearing, which is surrounded by spaced annular inner and outer flanges F and G respectively. The outer annular flange forms the peripheral edge of the enlarged rod end, and merges into the longitudinal side flanges L of the shank A, and bridges the space between the adjacent ends of the two shank flanges. The annular flanges F and G are of less width than the shank flanges A, which decrease in width from the wide intermediate portion to the points where they merge into the outer annular flange G. The web of the shank portion A is preferably widened out, as at H, as it joins the portion of the annular outer flange G that bridges the space between the two shank flanges.—*November 5th*, 1934.

CRUSHING AND GRINDING.

419,367. May 11th, 1933.—AIR SEPARATORS FOR USE IN CONJUNCTION WITH PULVERISERS, The British "Rema" Manufacturing Company, Ltd., Hubert Works, Highroad Well, Halifax, Yorks.; and P. Howden.

This invention is concerned with the classification of the material coming from a pulverising mill by pneumatic and centrifugal means. The annular exit from the mill is shown at A and is surmounted by an annular conical chamber B. Through this annulus the discharge of the powder and air takes place to the

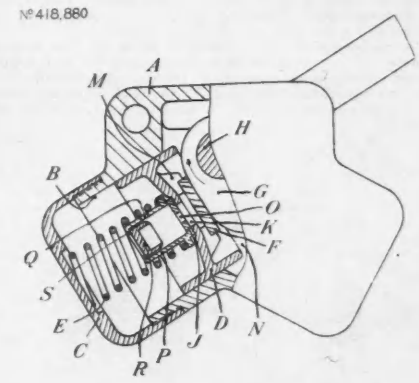


outlet C that may be bifurcated as shown and controlled by the damper D. The degree of fineness of the material delivered is controlled by the vanes E, which may be set at any angle to the line of flow of dust-laden air by the arms F and set screws G. The flow is naturally vortex-like, when unimpeded and carries away most of the ground material; but by adjusting the angle of the vanes E the vortex action may be, more or less, checked, and a lesser or larger proportion of the material returned, by gravity, to the grinder for further reduction.—*November 12th*, 1934.

MISCELLANEOUS.

418,880. December 16th, 1933.—HYDRAULIC SHOCK ABSORBERS, Robert Bosch Aktiengesellschaft, of 4, Militärstrasse, Stuttgart, Germany.

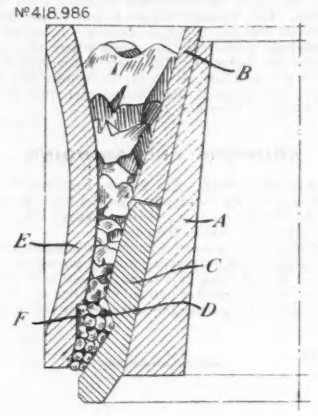
The casing A of a shock absorber described in this specification and which is fastened, for example, to the frame of the vehicle, has a cylindrical bore B, the lower end of which is closed by a sheet metal cap C. A piston D works in the cylinder B, and is pressed by a spring E with its pressure plate F against a cam G, fixed on a shaft H, and is connected by a lever mechanism (not shown) with the axle of the vehicle. Between the spring E and piston D is a disc J, which controls an opening K in the piston D. This opening is connected to the reservoir chamber N by intermediate spaces between the supporting ribs M for the pressure plate F. The disc J has an opening O and a cylindrical extension P in the wall of which an opening Q is provided. In the cylindrical extension P is a small piston R, the stroke of which is limited in one direction by a stop S and in the other direction by the bottom of the cylinder P. The cylinder B and the reservoir chamber N are filled with oil. When the cam



rotates in the clockwise direction it presses the piston D to the left. The oil compressed by the piston displaces the easily movable small piston R to the right, whereby it first closes the opening Q and then, in its end position, the opening O. As from this moment there is no longer any additional space in the pressure chamber which could receive liquid compressed by the piston, and also as oil can no longer escape through the opening O, the cushioning action of the shock absorber will now begin on further movement of the shock-absorbing piston to the left, and such cushioning action can be controlled in the usual way by a pressure valve. On the reverse movement of the cam G, the spring E presses the piston D to the right and the oil in front of the piston D pushes back the small piston R against the stop S, so that the openings O and Q again become free, and the cylinder B is again filled with oil. It is easy to see that this lost motion device is independent of the load on the vehicle, since the small piston R bears evenly at the beginning of the working stroke of the piston against its stop S. The idle motion device is thus effective in an equal degree from any initial position of the piston D.—*November 1st*, 1934.

418,986. April 5th, 1933.—CRUSHERS, Geoffrey Herbert Norman Coles and Edgar Allen and Co., Ltd., both of Imperial Steel Works, Sheffield.

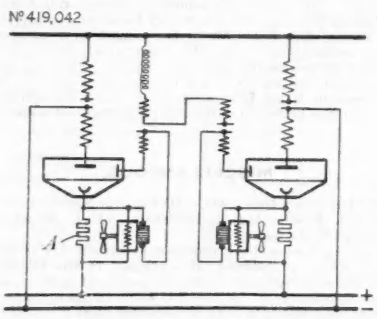
The object of the invention is to provide improvements in gyratory crushers for use, for instance, in the production of crushed or broken stone, whereby there may be obtained a crushed product of more "cubic" or, in other words, less flaky character than is yielded by gyratory crushers as hitherto constructed. On the movable conical crusher element or head A there is a mantle formed in two parts H and C, the latter of which is provided, adjacent to its lower extremity, with a recess or



groove D on its external surface and extending about its periphery. In this construction the liners E for the concave or bowl are each provided with a peripheral groove F immediately adjacent to the point of discharge. The two grooves form in effect a pocket in which some of the material undergoing crushing will be crowded, thus ensuring that the crushing pressure will largely be applied indirectly to such material and not by the direct action thereon of the crushing element. Some of the material to be crushed accumulates, and is retained while being subjected to a final crushing operation immediately before its discharge from the crusher.—*November 5th*, 1934.

419,042. May 29th, 1934.—MEANS FOR MERCURY ARC CONVERTERS, The English Electric Company, Ltd., of Queen's House, 28, Kingsway, London, W.C.2.

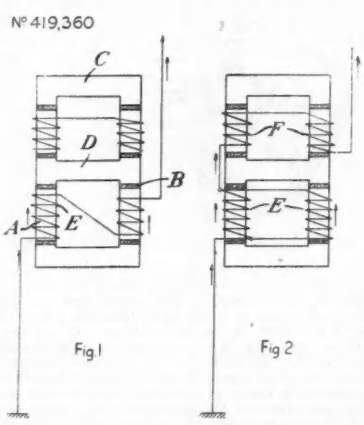
Means are described in this specification for driving the cooling fan of a mercury arc converter at a speed varying with the load. As shown in the illustration, a commutator motor is used for driving the fan and the armature is preferably connected in the secondary winding of the rectifier exciting transformer, the primary winding of the transformer being con-



nected in series with a high impedance. The armature of the motor is thus supplied with a current which is substantially constant at all motor speeds. The field winding is, however, connected across a resistance A in series with the D.C. circuit, and the current to the field winding, consequently, varies with the load. In an installation consisting of a number of rectifiers, it is advisable to connect all the primary windings of the exciting transformers in parallel and when disconnecting a rectifier the winding concerned is short-circuited.—*November 5th*, 1934.

419,360. April 11th, 1933.—ELECTRIC APPARATUS FOR COMPENSATING FOR AN EARTH FAULT CURRENT, *International General Electric Company, Inc., of 120, Broadway, New York, U.S.A.*

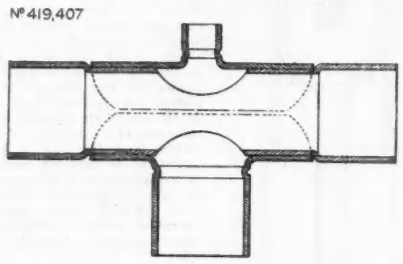
Electric networks are frequently to be operated at different voltages. In particular, it is often the intention to operate a network subsequently at a higher voltage. The installation is then correspondingly equipped for the higher voltage but is first run at a lower voltage. In cases of this kind, difficulties



are encountered in equipping the earth compensating devices, commonly known as Petersen coils, in such a way that they will fulfil their function at all voltages in the same manner, that is to say, are able to compensate the earth fault current. For this purpose, according to the invention, the choke coil is provided with a number of groups of coils mounted on a common iron core, each group being separated from adjacent groups magnetically by an intermediate yoke. The choke coil consists of separate limbs A, provided with air gaps B, the limbs being connected to one another by end yokes C, and an intermediate yoke D. The limbs A are provided with windings, which, according to the voltage to be applied, may either have the same or a different number of turns and may then be connected up separately or in series. Care must be taken in all cases, however, that the iron circuits for the separate coil groups are separated from one another, which is effected in the example shown by the intermediate yoke D, which must be kept free of air gaps. If the coils are to be employed for operating voltages which are in the ratio 1 : 2, for example, such as 50 kV and 100 kV, then only the lower coil group E will be switched in at the lower voltage, in accordance with Fig. 1 in such a way that the separate coil sections which are of equal size are placed in series. At the higher voltage, on the other hand, as shown in Fig. 2, the coil halves of group E are connected in parallel and placed in series with the coil group F. The coil group F likewise consists of two sectional coils, which may in themselves be connected in any desired manner. In the example they are arranged in series with one another.—*November 12th*, 1934.

419,407. October 27th, 1933.—PIPE FITTINGS, *L. Mellersh-Jackson, 28, Southampton-buildings, Chancery-lane, London, W.C.2.*

The object of this invention is to reduce to a minimum the stock of fittings required for making up a network of piping. The fittings are made up on the site by brazing, or soldering together standard stampings. In the case illustrated two branches of different diameters are required on opposite sides of the "through" line. They are formed of saddle-like stamp-



ings with sockets of appropriate diameters that are soldered over ports cut in the through line. The sockets in this case are the female type, and have heads pressed in them to prevent the branch pipes being pushed too far in. It will be readily appreciated that a large variety of combinations can be made up from a relatively small stock, and the load of the jobbing plumber correspondingly reduced. It is, for instance, shown that a stock of ten standard members will take the place of twenty-five tees.—*November 12th*, 1934.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INST. OF ELECTRICAL ENGINEERS: METER AND INSTRUMENT SECTION.—Savoy-place, W.C.2. "Theoretical and Practical Sensitivities of Gas-focussed Cathode-ray Oscillographs, and Effects of the Gas on their Performance," Professor J. T. MacGregor-Morris and Mr. J. A. Henley; "A Cathode-ray Oscillograph Equipment Embodying a High-voltage, Gas-filled, Sealed-glass Oscillograph Tube," Professor S. Parker Smith, Mr. C. E. Szeghö, and Mr. E. Bradshaw. 6 p.m.

INST. OF SANITARY ENGINEERS.—Caxton Hall, S.W.1. Presidential address, Mr. W. E. Blizard. 6 p.m.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. Informal meeting. Lecture, "Notes on Fine Measurement," Mr. F. H. Rolt. 7.30 p.m.

SATURDAY, JAN. 5TH.

INST. OF BRITISH FOUNDRYMEN: LANCS. BRANCH.—Engineers' Club, Manchester. "Impressions of a Recent Visit to United States of America," Mr. T. Makemson. 4 p.m.

ROYAL INST. OF GREAT BRITAIN.—21, Albemarle-street, W.1. Christmas Juvenile Lecture, V, "Telegraphs and Telephones," Prof. W. L. Bragg. 3 p.m.

MONDAY, JAN. 7TH.

BRADFORD ENGINEERING SOC.—Technical College, Bradford. "The Erection of Sydney Harbour Bridge," Mr. J. Walton. 7.30 p.m.

CHARTERED SURVEYORS' INST.—12, Great George-street, S.W.1. "Procedure in Arbitration," Mr. F. J. Wrottesley, K.C. 6.30 p.m.

ROYAL AERONAUTICAL SOC.—At Inst. of Electrical Engineers, Savoy-place, W.C.2. "Imperial Air Routes," Lt.-Commander B. W. Galpin. 6.30 p.m.

SOC. OF CHEMICAL INDUSTRY.—At Rooms of Chemical Soc., Burlington House, W.1. Jubilee Memorial Lecture. "The Fats: New Lines in an Old Chapter of Organic Chemistry," Professor T. P. Hilditch. 8 p.m.

TUESDAY, JAN. 8TH.

ILLUMINATING ENGINEERING SOC.—At Inst. of Mechanical Engineers, Storey's-gate, S.W.1. "A Cavalcade of Stage Lighting," Mr. L. G. Applebee. 6.30 for 7 p.m.

INST. OF AUTOMOBILE ENGINEERS.—At Royal Soc. of Arts, John-street, Adelphi, W.C.2. Presentation of Simms Gold Medal to Mr. A. H. Roy Fedden. "A Study of Road Performance," Mr. Maurice Platt. 7.45 p.m.

INST. OF BRITISH FOUNDRYMEN: BURNLEY SECTION.—Municipal College, Ormerod-road, Burnley. "High-duty Cast Irons in the Foundry," Mr. Geo. Hall. 7.15 p.m.

INST. OF CIVIL ENGINEERS.—Great George-street, S.W.1. Discussion. "The Construction of Silvan Dam, Melbourne Water Supply," Mr. A. E. Kelso; "The Water Supply of Murree and its Recent Extensions," Mr. J. A. R. Bromage and Mr. J. S. Sethi; "The Construction of the Silent Valley Reservoir, Belfast Water Supply," Mr. G. McIldowie. 6 p.m.

INST. OF ELECTRICAL ENGINEERS: SCOTTISH CENTRE.—39, Elmbank-crescent, Glasgow. "Generation, Distribution, and Use of Electricity on Board Ship," Messrs. C. W. Saunders, H. W. Wilson, and Dr. R. G. Jakeman. 7.30 p.m.

INST. OF ELECTRICAL ENGINEERS: S. MIDLAND STUDENTS.—James Watt Memorial Inst., Birmingham. "Supply Problems," Mr. W. Burton. 7 p.m.

INST. OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND: JOINT MEETING WITH INST. OF ELECTRICAL ENGINEERS, SCOTTISH CENTRE.—39, Elmbank-crescent, Glasgow, C.2. "Generation, Distribution, and Use of Electricity on Board Ship," Messrs. C. Wallace Saunders, H. W. Wilson, and Dr. R. G. Jakeman. 7.30 p.m.

INST. OF MARINE ENGINEERS.—The Minories, E.C.3. "Some Notes on Heat Transmission," Mr. E. F. Spanner. 6 p.m.

ROYAL INST. OF GREAT BRITAIN.—21, Albemarle-street, W.1. Christmas Juvenile Lecture, VI, "Oscillating Electrical iro uits," Prof. W. L. Bragg. 3 p.m.

SHEFFIELD METALLURGICAL ASSOC.—198, West-street, Sheffield, 1. Annual general meeting. 7.30 p.m.

SOC. OF GLASS TECHNOLOGY.—Visit to Royal Academy Exhibition of British Art in Industry. 11.15 a.m. At Chemical Soc., Burlington House, W.1. General discussion, "Art in Industry," 2 p.m. Trocadero Restaurant, London, annual dinner, 7.15 p.m.

WEDNESDAY, JAN. 9TH.

INST. OF CHEMICAL ENGINEERS.—Joint meeting with London Section of Soc. of Glass Technology. In Rooms of Chemical Soc., Burlington House, W.1. "A Review of Some of the Problems of the Glass Bottle Industry," Mr. W. A. Moorhead. 6 p.m.

INST. OF ELECTRICAL ENGINEERS: N. MIDLAND STUDENTS.—Imperial Hotel, Briggate, Leeds. Hot-pot Supper and entertainment. 8 p.m.

INST. OF ENGINEERS-IN-CHARGE.—St. Bride Inst., Bride-lane, E.C.4. "Elevating and Conveying Machinery," Mr. J. Marriott. 7.30 p.m.

NORTH-EAST COAST OF ENGINEERS AND SHIPBUILDERS: GRADUATE SECTION.—Bolbec Hall, Newcastle-upon-Tyne. "Ship Resistance," Mr. Arnold Emerson. 7.15 p.m.

THURSDAY, JAN. 10TH.

INST. OF ELECTRICAL ENGINEERS.—Savoy-place, W.C.2. "Electrical Developments in the U.S.S.R.," Mr. A. Monkhouse. 5.30 for 6 p.m.

INST. OF METALS.—At Rooms of Soc. of Motor Manufacturers and Traders, Ltd., 83, Pall Mall, S.W.1. "The Manufacture and Uses of Powdered Metals," Mr. J. C. Chaston. 7.30 p.m.

LLOYD'S REGISTER STAFF ASSOCIATION.—Board Room, 71, Fenchurch-street, E.C.3. "Marine Engines from the Superintendent's Point of View," Mr. Sterry B. Freeman. 5.15 p.m.

FRIDAY, JAN. 11TH.

INST. OF MECHANICAL ENGINEERS.—Storey's-gate, S.W.1. Informal meeting, "Automatic Railway Signalling," Mr. E. E. Pierce. 7 p.m.

NORTH-EAST COAST INST. OF ENGINEERS AND SHIPBUILDERS.—At Mining Inst., Newcastle-upon-Tyne. "Heavy Weather Damage," Mr. J. Foster King. 6 p.m.

SATURDAY, JAN. 12TH.

INST. OF MARINE ENGINEERS: JUNIOR SECTION.—The Minories, E.C. Dance. 7.30 p.m. to 11.15 p.m.

MONDAY, JAN. 14TH.

INST. OF CIVIL ENGINEERS.—Great George-street, S.W.1. Discussion, "The Perak River Hydro-electric Power Scheme," Mr. Bo Manne Hellstrom; "The Construction of the Chenderoh Water Power Plant of the Perak River Hydro-electric Power Scheme," Mr. W. J. H. Rennie. 6 p.m.

INST. OF CIVIL ENGINEERS: BELFAST AND DISTRICT ASSOC.—Physics Lecture Theatre, Queen's University, Belfast. "Precast Reinforced Concrete and its Use on Railway Work," Mr. W. F. Beatty. 5.45 for 6.30 p.m.

INST. OF METALS.—At 39, Elmbank-crescent, Glasgow, C.2. "Some Aspects of the Corrosion of Non-ferrous Metals," Prof. C. O. Bannister. 7.30 p.m.

TUESDAY, JAN. 15TH.

INST. OF AUTOMOBILE ENGINEERS.—King's Head Hotel, Coventry. "A Study of Road Performance," Mr. Maurice Platt. 7.30 p.m.

INST. OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—39, Elmbank-crescent, Glasgow, C.2. Discussion "Improved Methods of Presenting Ship Data," Introduced by Mr. Wilfrid Ayre. 7.30 p.m.

INST. OF METALS.—James Watt Memorial Inst., Birmingham. "The National Smelting Works, Avonmouth," by a Member of the Staff. 7 p.m.

ROYAL EMPIRE SOC.—Edward VII Rooms, Hotel Victoria, Northumberland-avenue, W.C.2. "Pioneer Work by British Engineers." (i) "The Sydney Bridge," Mr. Ralph Freeman; (ii) "Ports, Bridges, and Railways in the East," Mr. J. Tritton; (iii) "Railway Development in the Colonies," Brig.-General F. D. Hammond; (iv) "Irrigation in India," Colonel H. Pollard-Lowsley. 8.30 p.m.

WEDNESDAY, JAN. 16TH.

INST. OF AUTOMOBILE ENGINEERS.—Queen's Hotel, Leeds. "The Utilitarian Æsthetics of Automobile Body Design," Mr. W. O. Pennington. 7.15 p.m.

INST. OF CIVIL ENGINEERS.—Great George-street, S.W.1. Informal meeting. Discussion, "Methods and Organisation for Providing an Abundant and Cheap Supply of Electricity to Consumers in the Country," Mr. F. W. Shilstone. 6 p.m.

INST. OF MECHANICAL ENGINEERS: N. WESTERN BRANCH.—9, The Temple, Dale-street, Liverpool. The Thomas Lowe Gray Lecture, "A Survey of Ships and Engines," Mr. Loughnan St. L. Pendred. 6.30 p.m.

THURSDAY, JAN. 17TH.

INST. OF MARINE ENGINEERS: JUNIOR SECTION.—The Minories, E.C. Film display and lecture, "The Manufacture of Aero Engines," Mr. J. D. Pearson. 7 p.m.

INST. OF MECHANICAL ENGINEERS: N. WESTERN BRANCH.—The Engineers' Club, Albert-square, Manchester. "Air Swirl in Oil Engines," Mr. J. F. Alcock. 7.15 p.m.

FRIDAY, JAN. 18TH.

RAILWAY CLUB.—57, Fetter-lane, E.C.4. "The Eastern Section of the Great Central Railway," Mr. E. B. Woodruffe-Peacock.

MONDAY, JAN. 21ST.

INST. OF AUTOMOBILE ENGINEERS.—At Inst. of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow "Graphite Lubrication," Mr. H. Higinbotham. 7.30 p.m.

TUESDAY, JAN. 22ND.

INST. OF ELECTRICAL ENGINEERS: SCOTTISH CENTRE.—North British Station Hotel, Edinburgh. "A Critical Examination of the Present Practice relating to the Electrical Warming and Air-conditioning of, and the Supply of Hot Water to, the Larger Buildings," Messrs. R. Grierson and D. Betts. 7 p.m.

WEDNESDAY, JAN. 23RD.

INST. OF AUTOMOBILE ENGINEERS.—Engineers' Club, Manchester. "Graphite Lubrication," Mr. H. Higinbotham. 7 p.m.

INST. OF CIVIL ENGINEERS: YORKSHIRE ASSOC.—Royal Victoria Station Hotel, Sheffield. Annual dinner; reception 6.30 p.m., dinner 7 p.m.

ROYAL SOC. OF ARTS.—John-street, Adelphi, W.C.2. "Humidity, Health, and Some New Inventions," Mr. C. L. Burdick. 8 p.m.

MONDAY, JAN. 28TH.

INST. OF CIVIL ENGINEERS: BELFAST AND DISTRICT ASSOC.—Physics Lecture Theatre, Queen's University, Belfast. "The Silent Valley Reservoir," Mr. G. McIldowie. 5.45 for 6.30 p.m.